FIRST FIVE-YEAR REVIEW REPORT FOR LOCKWOOD SOLVENT GROUNDWATER PLUME SUPERFUND SITE YELLOWSTONE COUNTY, MONTANA

Prepared by

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LIST OF ABBREVIATIONS AND ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirement
bgs	Below Ground Surface
BHHRA	Baseline Human Health Risk Assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CGA	Controlled Groundwater Area
Cis-1,2-DCE	Cis-1,2-Dichloroethylene
COC	Contaminant of Concern
DNRC	Department of Natural Resources and Conservation
EA	Excavation Area
EPA	United States Environmental Protection Agency
ERD	Enhanced Reductive Dechlorination
EVO	Emulsified Vegetable Oil
FS	Feasibility Study
FYR	Five-Year Review
HQ	Hazard Quotient
IC	Institutional Control
ISB	In-situ Bioremediation
LTC	Landfarm Treatment Cell
MCL	Maximum Contaminant Level
MDEQ	Montana Department of Environmental Quality
µg/L	Micrograms per Liter
$\mu g/m^3$	Micrograms per Cubic Meter
mg/kg	Milligrams per Kilogram
mg/kg/day	Milligrams per Kilogram per Day
mg/m^3	Milligrams per Cubic Meter
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
O&M	Operation and Maintenance
OS	Ozone Sparge
OU	Operable Unit
PCE	Tetrachloroethylene
PRP	Potentially Responsible Party
RAO	Remedial Action Objective
RI	Remedial Investigation
ROD	Record of Decision
RPM	Remedial Project Manager
RSL	Regional Screening Level
Soco	Soco West, Inc.
SVE	Soil Vapor Extraction
TCE	Trichloroethylene
UU/UE	Unlimited Use and Unrestricted Exposure
VIA	Vapor Intrusion Assessment
VISL	Vapor Intrusion Screening Level
VOC	Volatile Organic Compound
VR	Vapor Recovery

I. INTRODUCTION

The purpose of a five-year review (FYR) is to evaluate the implementation and performance of a remedy to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings and conclusions of reviews are documented in FYR reports such as this one. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The U.S. Environmental Protection Agency (EPA) is preparing this FYR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, consistent with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 Code of Federal Regulations (CFR) Section 300.430(f)(4)(ii)) and considering EPA policy.

This is the first FYR for the Lockwood Solvent Groundwater Plume Superfund site (the Site). The triggering action for this statutory review is the on-site construction start date of the remedial action for operable unit (OU) 2. The FYR has been prepared because hazardous substances, pollutants or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure (UU/UE).

The Site consists of two Operable Units (OUs). OU1 addresses the soil and groundwater remedy at the Beall property source area however, the protectiveness of the OU1 remedy is not evaluated in this FYR because it is currently in the remedial design phase. This FYR addresses the OU2 soil and groundwater remedy at the Soco West property source area. EPA OU2 remedial project manager (RPM) Roger Hoogerheide (OU2) led the FYR. Participants included Montana Department of Environmental Quality (MDEQ) project manager Richard Sloan, and Ryan Burdge and Claire Marcussen from EPA FYR contractor Skeo. The potentially responsible party (PRP) for OU2 was notified of the initiation of the FYR. The review began on 6/14/2021. Appendix A lists the documents used to prepare this FYR Report. Appendix B provides a brief site chronology.

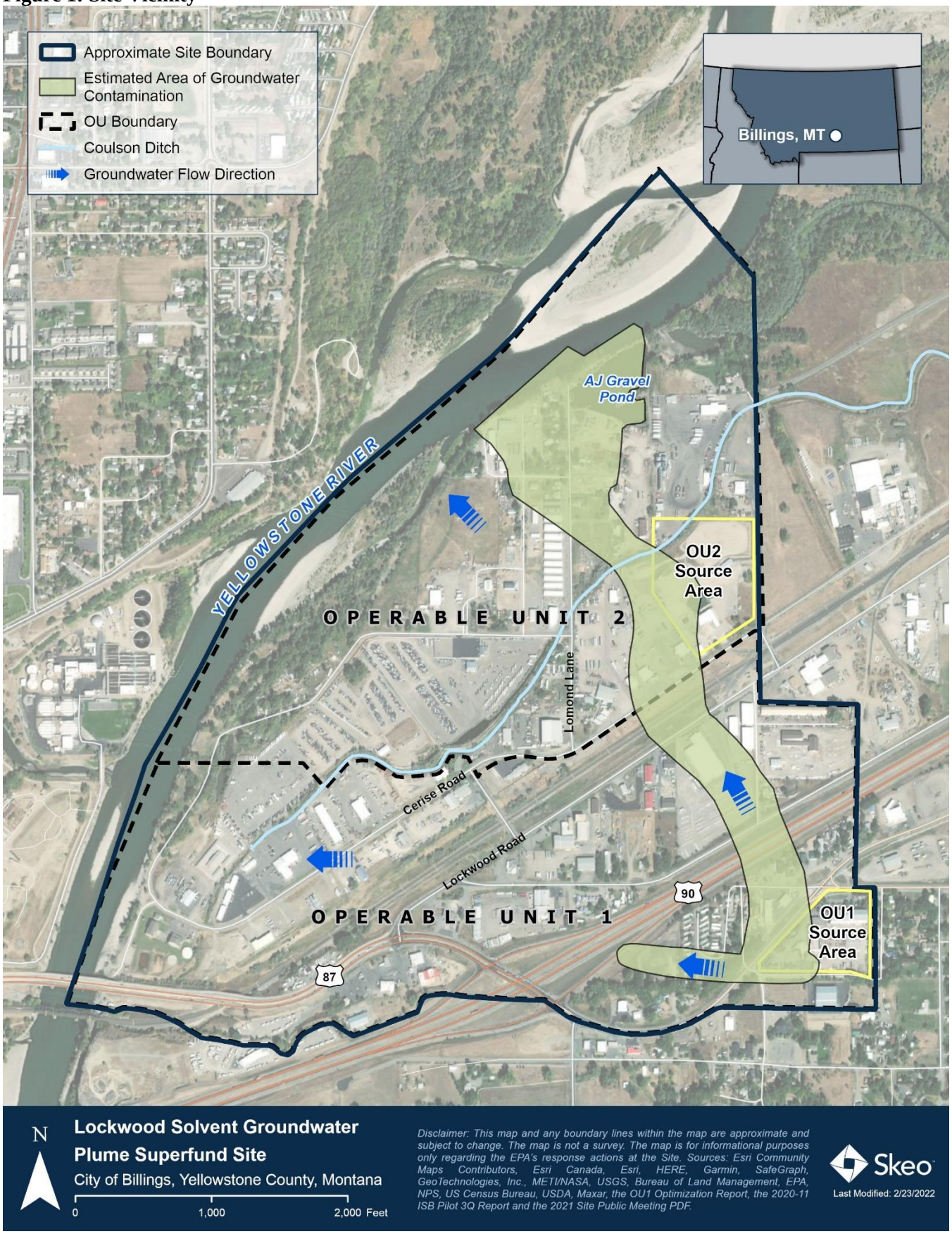
The EPA has determined in the FYR that the cleanup at OU2 of the Lockwood Solvent Groundwater Plume Superfund site will be protective. This means that the remedy is currently under construction. Upon completion, and based on the progress to date, the EPA expects the remedy to be protective and no remedy implementation or performance issues have been identified. The protectiveness of the OU1 remedy was not evaluated in this FYR because it is currently in the remedial design phase, and cleanup has not begun.

Site Background

The Site is in Lockwood, Montana, in an area of mixed residential, light-industrial and commercial uses (Figure 1). The Site is bounded to the west by the Yellowstone River. The Site includes a 580-acre area where contaminated groundwater spread from sources at two former industrial facilities. The facility on the southern part of the Site, known as the former Beall's Trailers of Montana, Inc. (currently leased by MAC Liquid Tank Trailer Manufacturing and owned by MAC LTT, LLC) (OU1), manufactured and reconditioned tank trailers for the petroleum and asphalt industries from 1978 to 1990. OU1 site operators cleaned trailers using a solution of dissolved trichloroethylene (TCE) and steam prior to maintenance or repair. The wastewater from the steam-clean bay was discharged to a septic system and drain field. The second facility, located on the northern part of the Site, Former Brenntag West, Inc. (now Soco West (Soco) (OU2)), stored, repackaged and sold chlorinated solvents between 1972 and the 1990s. Both facility operations resulted in the release of chlorinated solvents to soil and groundwater.

The Coulson Ditch bisects the northern portion of the Soco property (Figure 1). The ditch was constructed in the late 1800s and supplied irrigation water for the Coulson Water Users Association downriver from the Site. The ditch flowed from a diversion on the Yellowstone River to the northeast, through several properties, and then northeast and through the northwestern portion of the OU2 property. The ditch exits the Site via a culvert at the OU2 eastern boundary. The ditch was taken out of service in approximately 2008 and is no longer in use.

Figure 1: Site Vicinity



However, Coulson Ditch is an important site feature because the Yellowstone River can breach the inlet gate during flood events and inundate low lying areas of the Site. This happened in late June 2022 when the Yellowstone River crested at 16 feet above normal flow and caused significant flooding along Lomond Lane north of Coulson ditch.

The ditch has not been backfilled or reclaimed in any way, but it may intersect the water table during portions of the year. No flowing water has been observed since the ditch was taken out of service except during the June 2022 flood event. Stormwater runoff at the Site is primarily controlled by ditches alongside the principal roads and through storm sewers managed by the Lockwood Water and Sewer District. Sampling conducted during the remedial investigation indicated that COCs in wells located adjacent to the river exceeded state discharge criteria for site-related COCs, but the RI concluded that the discharge of contaminated groundwater had negligible impact to the Yellowstone River.

Site groundwater occurs in the shallow alluvial aquifer that overlies a sandstone bedrock that is encountered, on average, between 30 and 60 feet below ground surface (bgs). The alluvial aquifer is the preferential pathway for contaminants to migrate, and data collected so far suggest that the bedrock unit likely impedes downward vertical groundwater flow. The alluvium at OU1 is overlain by a vadose (unsaturated) zone with thickness ranging from 35 feet to 47 feet. The vadose zone thickness at OU2 ranges from 10 to 15 feet. The alluvial aquifer generally flows to the northwest from both OUs toward the Yellowstone River[1]. A portion of the OU2 plume discharges into the AJ Gravel Pond and then eventually discharges to the Yellowstone River.

The primary source of domestic and industrial use water in the site area is from the Lockwood Water and Sewer District Public Water Supply, which obtains its water from the Yellowstone River. Historically, some full-use domestic, irrigation, commercial and non-domestic use water was used from the shallow alluvial aquifer via several individual wells. Through removal actions, impacted residents and businesses using potable wells impacted by the Site have been connected to the public water supply. However, limited other non-potable uses such as irrigation and commercial use water is known to come from the shallow alluvial aquifer via individual wells.

[1] External pumping associated with municipal wells that were managed by Lockwood water and sewer district in the 80s and 90s has influenced groundwater flow direction in OU1.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Lockwood Solvent Groundwater Plume		
EPA ID: MT0007623052		
Region: 8	State: Montana	**City/County:** Billings/Yellowstone
SITE STATUS		
NPL Status: Final		
Multiple OUs? Yes	**Has the Site achieved construction completion?** No	
REVIEW STATUS		
Lead agency: EPA		
Author name: Roger Hoogerheide and Tillman McAdams with support from Skeo		
Author affiliation: EPA Region 8 and Skeo		
Review period: 6/14/2021 - 7/31/2022		
Date of site inspection: 8/18/2021		
Type of review: Statutory		
Review number: 1		
Triggering action date: 7/31/2017		
Due date *(five years after triggering action date)*: 7/31/2022		

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

In October 1986, Lockwood Water and Sewer District personnel discovered the presence of benzene and chlorinated solvents in their water supply wells. That discovery led to the initiation of a number of investigations by MDEQ of underground storage tanks and a petroleum pipeline in the vicinity of the Lockwood Water and Sewer District property.

The MDEQ completed a sitewide baseline human health risk assessment (BHHRA) in 2003 based on the EPA's risk assessment guidance for Superfund Sites. The BHRRA evaluated the following exposure scenarios:

- Resident adults and children using potable water and breathing indoor air.
- Resident adults using contaminated well water to wash cars or irrigate their lawn.
- Resident adolescents recreating with contaminated well water in kiddie pools or sprinklers.
- Recreators fishing from or wading in the AJ Gravel Pond.
- Utility/construction workers exposed to contaminated soil and groundwater.
- Industrial workers using potable water.

The results of the BHHRA demonstrated cancer risks and noncancer hazards associated with residential and industrial receptors exposed to groundwater which supported the need for a response action. The BHRRA demonstrated that the following scenarios and receptors had cancer risks indicating the need for further evaluation or remediation:

- Industrial workers in source subareas who use contaminated groundwater for unrestricted workplace use, including drinking and washing.
- Industrial workers in the OU2 Source Area who spend at least 4 hours of each workday in contact with groundwater.
- Resident adults and children in both OU1 and OU2 Source Areas using contaminated groundwater for whole-house use including bathing, drinking and washing.

While none of the maximum detected concentrations in surface soil exceeded the screening values in the BHHRA for direct contact, the soil pathway was considered a source of contamination to the groundwater because subsurface soil contaminant concentrations exceeded leachability-based soil screening levels. The 2005 Record of Decision (ROD) concluded that persons living above the contaminated groundwater may be adversely exposed to contaminated indoor air; therefore, continued monitoring and evaluation of indoor air contaminant concentrations is ongoing (EPA 2005). Table 1 provides a summary of the contaminants of concern (COCs) driving the unacceptable risk by environmental medium. While there are other volatile organic COCs present at the Site, the BHHRA identified four COCs contributing the majority of the risks at the Site (Table 1).

The MDEQ also completed a baseline ecological risk assessment (BERA) in 2003. It included a detailed screening of all detected contaminants in soil, sediment and surface water against the most conservative available ecological screening values. The MDEQ found all surface water, sediment, and soil concentrations were below conservative screening values. Additionally, a conservative food model was employed to evaluate top-level avian carnivores such as the bald eagle. The results of the baseline ecological risk assessment indicated the Site does not pose an unacceptable risk to ecological receptors.

Table 1: COCs and Media

COC	Media[a]
Tetrachloroethylene (PCE) Trichloroethylene (TCE) Cis-1,2-Dichloroethylene (Cis-1,2-DCE) Vinyl chloride	Soil, Groundwater, Surface water

COC	Media[a]
Notes: a. PCE and TCE were released by former site operations and these COCs formed chemical breakdown products of cis-1,2-DCE and vinyl chloride. All four COCs are present in soil, groundwater and surface water (AJ Gravel Pond). *Source:* The Site's 2005 ROD.	

Response Actions

In the summer of 1999, the EPA initiated an emergency removal action to provide bottled water to affected residences where domestic water exceeded the state drinking water standards in samples collected by the MDEQ and continued to supply potable water until the affected properties could be connected to the main public water supply. The EPA's Emergency Removal Program completed the extension of the public water supply line to the Lomond Lane area for 14 residences with contaminated wells in October 2000.

The EPA proposed listing the Site on the Superfund program's National Priorities List (NPL) in May 2000. The EPA's Superfund Technical Assessment and Response Team completed residential indoor air sampling in 1999 and 2000 to evaluate health risks from vapor intrusion of chlorinated solvents into area residences. The July 2000 Indoor Air Sampling Report indicated the need for vapor intrusion mitigation in two homes. Vapor mitigation was performed in these homes. Post-mitigation sampling indicated reduced concentrations of chlorinated solvent vapors in these homes. The EPA finalized the Site's listing on the NPL in December 2000.

Since 2004, Soco has managed a soil vapor extraction (SVE)/ozone sparging system in the Northwest Source Area. With expansion of the system in 2017, the SVE system is now a component of the groundwater remedy at OU2.

The EPA signed the Site's ROD in August 2005 to address contamination at OU1 and OU2 source areas and site-wide groundwater. The ROD identified remedial action objectives (RAOs) for the OU1 and OU2 soil and groundwater/surface water remedies to achieve. Sitewide RAOs are:

- Groundwater and surface water
    - Prevent exposure of humans to groundwater and surface water contaminants in concentrations above regulatory standards.
    - Reduce contaminant concentrations in the alluvial aquifer and surface water to below regulatory standards.
    - Prevent or minimize further migration of the contaminant plume.
- Soil
    - Prevent or minimize further migration of contaminants from source materials (soil) to groundwater.

Table 2 summarizes the Site's remedy components, as selected in the 2005 ROD. Table 3 summarizes the ROD cleanup goals for groundwater, surface water and soil.

Table 2: Remedy Components

Media	Remedy Component
Site-wide Groundwater/Surface Water	• Source Area - Enhanced bioremediation (EB) and in-situ bioremediation (ISB). • Plume Area - EB system in treatment zones in one or more locations and may include ISB. • Long-term groundwater and indoor air monitoring to include contingencies for immediate protection of human health (e.g., vapor mitigation systems, provision of a permanent potable supply, plugging wells). • Monitored natural attenuation following source remediation and groundwater treatment. • Institutional controls restricting groundwater use, to protect remedy components, and educate the public about the Site.
Site-wide Source Area Soils	• Implementation of institutional controls to protect remedy components.
Soil OU1	• Soil vapor extraction (SVE) of vadose zone soil in the source area.
Soil OU2	• Excavate accessible vadose and saturated soil and treat using ex-situ low temperature thermal treatment on site and reuse treated soil to backfill excavated areas. • Injection of chemical oxidants may be used to treat inaccessible contaminated saturated soil during the excavation process. • SVE/Ozone sparging to treat inaccessible contaminated vadose zone soils.

Table 3: COC Cleanup Levels

COC	Sitewide Surface Water and Groundwater (µg/L)[a]	Soil (mg/kg)[b]	
		OU1	OU2
PCE	5	0.22	0.65
TCE	5	0.24	0.72
Cis-1,2-DCE	70	1.64	4.90
Vinyl chloride	2	0.05	0.16

Notes:
a. Maximum contaminant levels (MCLs) established under the Safe Drinking Water Act.
b. Leachability-based cleanup goals using OU-site-specific information on infiltration rates, soil type and dilution attenuation factors.
µg/L = micrograms per liter
mg/kg = milligrams per kilogram
Source:
The Site's 2005 ROD. Table 29 and Table 30 include the soil cleanup goals for OU2 and OU1, respectively. Table 31 includes the cleanup goals for groundwater and surface water.

Status of Implementation

OU1 remedy implementation has not yet been initiated.

Soco is the lead for completing the remedial design and remedial action at OU2. OU2 is in the remedial action phase with enhanced bioremediation pilot studies ongoing to optimize the remedy. If necessary, the EPA will modify the final remedy to record any remedy modifications implemented following the optimization assessment.

In October 2011, the Consent Decree was entered in United States District Court for the District of Montana that outlines the procedures, tasks, requirements and schedule for the work to be performed by Soco at OU2. Soco began the remedial design of the soil and groundwater remedies in August 2011. Between September 2012 and September 2014, the EPA conducted a remedial design optimization review for the selected remedy for OU2. The review was conducted to optimize the remedial response to address contamination in soil and groundwater to achieve maximum protectiveness while improving remedy cost and energy efficiency and minimizing time required to attain cleanup levels. The optimization review identified the following recommendations to optimize the remedial design process and long-term remedy performance:

- Install more groundwater well clusters for the source and immediate downgradient plume to identify the intervals of highest contamination.
- Prepare highly detailed OU2-specific cross sections that highlight low-permeability seams and areas of highest contaminant mass.
- Expand the ozone sparge/vapor recovery (OS/VR) for the Northwest Source Area originally initiated in 2004 and other nearby highly contaminated primary source areas.
- Excavate and treat highly contaminated, low-permeability, shallow soil (above 20 feet below ground surface, or bgs) with ex-situ SVE/ozone sparging.
- Implement ISB treatment in the source area based on the additional site characterization recommended above. Add the ISB amendment at the base of the excavations to treat deeper areas of contamination at and below the water table in the source area.
- Conduct performance monitoring of the source remedy for three to five years after implementation.
- Prioritize source area remediation.
- Delay implementation of an ISB remedy in the dissolved leading edge of the groundwater plume until three to five years of source area remedy performance data have been collected and analyzed.
- Monitor the northern and eastern edges of the plume near well MW-006, where concentrations may be increasing because groundwater flow is no longer influenced by pumping from historical operations at the gravel pond.

Vapor Intrusion Assessment

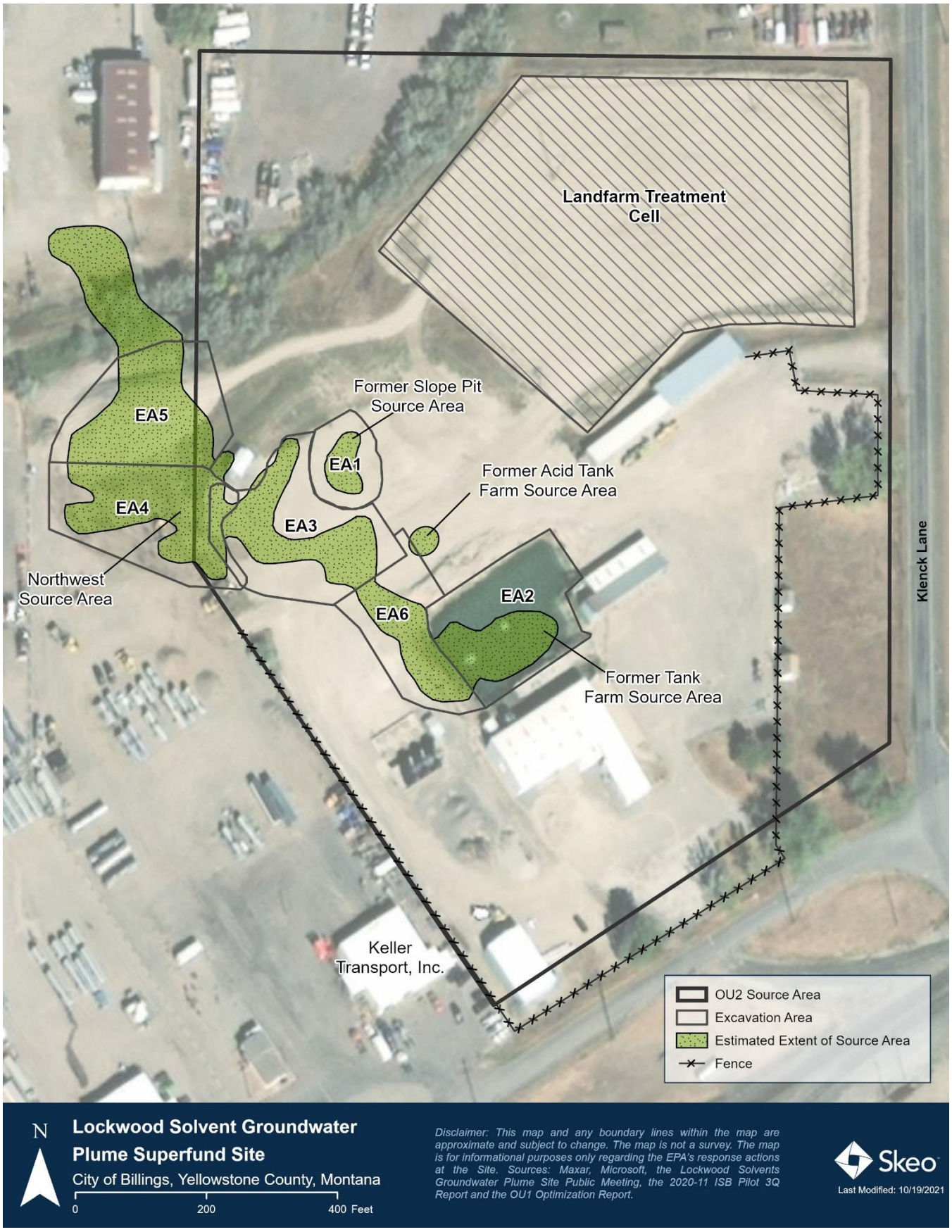
The EPA evaluated historic groundwater analytical data from 2003 through 2010 and used those data in the Johnson-Ettinger vapor intrusion model and determined that the pathway for COC vapors to migrate from groundwater and soil into structures within the OU2 unit required additional investigation. This determination was based primarily on the revised 2012 non-cancer toxicity factors developed for Tetrachloroethylene (PCE) and TCE. The 2013 VIA was conducted to determine if vapor intrusion is occurring to an extent that poses a risk to human health in inhabited structures. In 2021, Soco completed follow-on vapor intrusion sampling. PCE and TCE concentrations detected in residences during the 2013 and 2021 VIAs were below the 1×10^{-5} risk and below the noncancer-based RSLs. As part of each investigation, Soco evaluated multiple lines of evidence (data from groundwater, soil vapor, sub-slab vapor, indoor air, crawl space area and ambient air samples) and concluded vapor intrusion does not present an unacceptable risk to residents. This exposure pathway will continue to be monitored as the remedy implementation progresses.

Source Area Soil

As part of the remedial design activities, Soco completed source area characterization between July 2014 and August 2016 to further delineate contaminated soil. Soco identified four main source areas at the Site: the Northwest Area, the Former Tank Farm Area, the Former Slope Pit Area and the Former Acid Tank Farm Area (Figure 2). Given space limitations on Site, the agencies agreed to allow soils to be excavated from these four source areas in six phases. The soils removed from the six excavation areas (also referred to as EA1 through EA6) located across the four source areas would be treated over a six-year period. Activities include placement of excavated soils in an on-Site landfarm treatment cell (LTC), tilling of the soils each summer and soil sampling to determine if the cleanup goals are met prior to placement of the soils back in the excavated areas.

Soco began the OU2 source soil remedial action in July 2017. Between July 2017 and October 2021, Soco excavated source areas soils at the five primary source areas (the Northwest Area, the Former Tank Farm Area, the Former Slope Pit Area and an area west of the Former Acid Tank Farm Area) (Figure G-1). In March 2018, Soco removed concrete from the Former Slope Pit Tank Farm and the Former Tank Farm Area source areas to allow access to the fine-grained source soils targeted for excavation and remediation located underneath and/or adjacent to the former tank farms. Soco excavated soils to the bottom of the fine-grained soil layer (about 10 to 14 feet bgs) or until groundwater was encountered. Soco also extended the excavations by an additional buffer area of about 20 feet around the approximated perimeter limits of each excavation to ensure removal of source soils. Source soil confirmation data are further discussed in the Data Review section of this FYR Report.

Figure 2: Detailed OU2 Source Area Map



During soil remediation, Soco identified about 3,000 cubic yards of additional soil contamination in the vadose zone north of Coulson Ditch and EA5 in November 2018 (Figure 2). Between November 2019 and March 2020, Soco injected an emulsified vegetable oil (EVO) mixture in 18 injection wells north of Coulson Ditch as part of an enhanced bioremediation pilot test to evaluate whether this mixture is effective in providing favorable conditions (e.g., anaerobic) for microbial degradation. The data collected during this pilot test has determined that enhanced bioremediation is a suitable technology for full-scale implementation north of Coulson Ditch and additional injections wells. A second EVO injection began in May 2022 and is ongoing at the time this FYR was finalized. Additional injections points are proposed in 2022 once the recently-flooded areas along Lomond Lane are dry enough to allow heavy equipment on Site. Table 4 provides a summary of the soil remediation completed to date. Cleanup of EA6 has not yet occurred but will be excavated in the sixth phases of soil treatment in fall 2022 and will be treated in the LTC in 2023.

Table 4: OU2 Soil Remediation Completed, 2017 to 2021

Excavation Area (EA)	Date	Description
Former Slope Pit Source Area (EA1)	November 2017	Excavated about 2,383 cubic yards of contaminated soil and placed in the LTC.
	May to August 2018[a]	Excavated soils treated in the LTC.
	August 2019	Treated soils placed in the EA1 and EA3 excavations.
Former Tank Farm (EA2)	September to October 2018[a]	Excavated about 12,684 cubic yards of contaminated soil.
	June to September 2019	Treated excavated soil in the LTC.
	August 2019	Treated soils placed in EA1 and EA3 excavations. EA2 left open and aerators placed in the excavation to treat contaminated groundwater.
West of Former Acid Tank Farm Area (EA3)	September to October 2019[a]	Excavated about 11,467 cubic yards of soils.
	July to September 2020	Excavated soils treated in the LTC.[b]
	October 2020	Placed treated soils in EA3 excavations.
Northwest Area (located on adjacent property to the west) (EA4)	September to October 2020	Excavated about 11,444 cubic yards of contaminated soil.[c]
	Summer 2021	Treated excavated soil along with remaining EA3 excavated soils in the LTC.
	October 2021	Placed treated soils in EA5 excavation
Northwest Area (located on adjacent property to the west) (EA5)	October 2021	Excavated approximately 12,000 cubic yards of soil
	Summer 2022	Treat EA5 excavated soil along with remaining EA4 excavated soils in the LTC.

Notes:

a. Soco removed the concrete for the Former Slope Pit Tank Farm and the Main Former Tank Farm in 2018 and at the Former Acid Tank Farm in May 2019. Soco used the crushed concrete to build up access into the LTC during the excavation of EA3.
b. Soco expanded the LTC in March and April 2020.
c. Soco shut down the OS portion of the OS/VR system in April 2020, due to damage caused by a third party conducting dirt work on the adjacent property. In September 2020, Soco shut down the west VR system and removed the west system conveyance lines to allow for the excavation of EA4.

Source Area Groundwater

In 2015, Soco expanded the OS/VR pilot scale test originally started in 2004 to evaluate the treatment of impacted groundwater within the Northwest Source Area of OU2. Soco expanded this system west and north within the Northwest Source Area in September 2017, which was the initiation of groundwater remedial action. Soco has expanded the OS/VR system over the years. It included over 30 sparge points that inject air/ozone into the subsurface and 24 VR trenches designed to capture the contaminants as they volatilize in the subsurface. The system has removed about 1,620 pounds of contaminants from groundwater and soil since October 2004. Several components of the sparge system had to be dismantled between 2018 and 2021, as soils were excavated in EA2 – EA5. Soco will reconstruct these components once the excavated OU2 soils have been treated and backfilled.

Downgradient of Source Area Groundwater

In 2017, Soco initiated a groundwater enhanced bioremediation pilot test to evaluate the technology to create a downgradient groundwater treatment (permeable reactive) barrier system to treat chlorinated solvent-impacted groundwater north of Coulson Ditch. In August 2020, the enriched bioaugmentation culture BAC-9, capable of degrading chlorinated solvents, was injected into the enhanced bioremediation injection wells, along with anerobic chase water to facilitate dechlorination of OU2 COCs to innocuous compounds. Sampling of the groundwater is ongoing. Preliminary results indicate a decrease in PCE concentrations in groundwater samples collected from several monitoring wells north of Coulson Ditch in the enhanced bioremediation pilot test area. However, recent groundwater observations indicate a stall in the degradation of DCE and VC to ethene; slow progress on bioremediation in some of the "D" wells; and low expansion of EB progress downgradient. Additional EVO injections commenced in May 2022 with a doubling of the amount of EVO injected per well to address these recent observations. Several new injection points and monitoring wells are also anticipated to be installed to the west of the existing system in 2022 once the flooded areas are dry enough to allow equipment on Site.

Institutional Control (IC) Review

The 2005 ROD included site-wide institutional controls as a remedy component to prevent use of contaminated aquifers for domestic purposes, prevent migration of contaminated groundwater due to excessive withdrawal, provide community information and education, require site monitoring, and describe procedures for immediate protection of human health for area residents and workers. The institutional controls required as outlined in the 2005 ROD include:

- Establishment of a permanent controlled groundwater area (CGA).
- Filing of deed notices/deed restrictions to protect engineered remedy components.
- Creation of a community awareness/education program to inform the public about the following topics:
    - Health risks associated with the use of contaminated groundwater.
    - Safe use of contaminated well water for certain purposes.
    - Measures to reduce the risks from contaminated vapors in indoor air.
    - Remedial components.
    - Construction and monitoring schedules and potential impacts on the community.

In September 2018, the Montana Department of Natural Resources and Conservation (DNRC) established a CGA for the Site which includes the groundwater contaminant plumes across both OUs. The Notice of Adoption of the LSGPS CGA (36-12-907) was entered into the Montana Administrative Register, Issue 19, on October 5, 2018 (Appendix K). The CGA restricts groundwater withdrawals to protect human health and to prevent contaminant migration, which may expand the contaminated groundwater plumes beyond the current extents. More institutional controls are planned through the filing of deed restrictions to protect the final constructed engineered remedy components. In the interim, the PRP uses engineering controls such as fencing and signs to prevent access to areas where remediation or pilot studies are occurring. In addition, the EPA continually updates the site profile page to keep the public informed, periodically mails fact sheets to the public, and holds public meeting.

Table 5 lists the institutional controls implemented to date as well as institutional controls planned for the future. Figure 3 shows the outline of the CGA. As shown in Figure 3, the OU boundaries encompass large areas that had previously been considered to contain groundwater or soil contamination. The EPA will consider revising the OU boundaries to only encompass contaminated soil and groundwater.

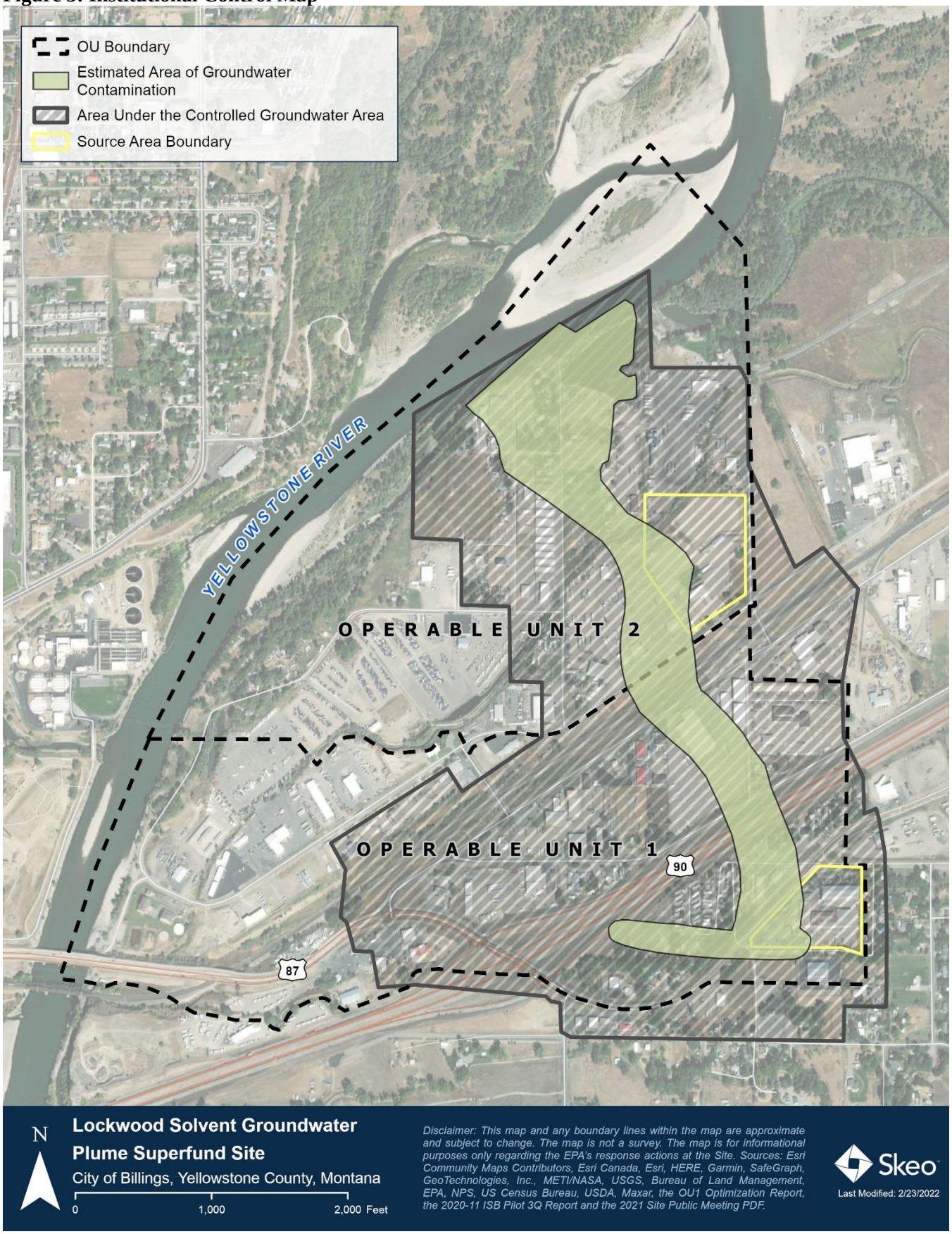
Table 5: Summary of Planned and/or Implemented Institutional Controls (ICs)

Media and Engineered Controls That Do Not Support UU/UE Based on Current Conditions	ICs Needed	ICs Called for in the Decision Documents	Impacted Parcel(s)	IC Objective	Title of IC Instrument Implemented and Date (or planned)
Site-wide Groundwater	Yes	Yes	See Figure 2	Restrict groundwater use and installation of groundwater wells.	Controlled Groundwater Area Adopted on October 5, 2018, Montana Code Annotated section 85-2-506.
OU2 Soil and Engineered Remedy Components	Yes	Yes	To be determined	Prevent interference with the engineered remedial components located on the properties until cleanup levels are met.	Deed restrictions where engineered components of the remedy have been or will be constructed.

Systems Operations/Operation and Maintenance (O&M)

An O&M Plan has not yet been prepared for OU1 or OU2 as the remedies have not yet been fully constructed. Soco, the OU2 PRP, is in the process of implementing the OU2 remedy, while the EPA is in the remedial design phase of the OU1 remedy. However, in the interim, monitoring of the OU2 remedy components implemented so far and additional monitoring associated with the pilot studies at OU2 are ongoing.

Figure 3: Institutional Control Map



III. PROGRESS SINCE THE PREVIOUS REVIEW

This is the Site's first FYR.

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Community Involvement and Site Interviews

A public notice was made available by a newspaper posting in the Billings Gazette, on 10/31/2021 (Appendix C). It stated that the FYR was underway and invited the public to submit any comments to the EPA. No comments were submitted for the EPA to consider. The results of the review and the report will be made available at the Site's information repository, Montana State University – Billings Library – Reference Section, located at 1500 University Drive Billings, Montana 59101, as well as on the EPA's site profile page at **www.epa.gov/superfund/lockwood-solvent.**

In February 2021, the EPA developed a community mailing and fact sheet and hosted a virtual public meeting to update the public about the Site.

During the FYR process, interviews were conducted to document any perceived problems or successes with the remedy implemented to date**.** The interviews are included in Appendix D and summarized below.

MDEQ – Project Manager Richard Sloan indicated that OU2 is progressing well and noted no issues. For OU1, Mr. Sloan noted that despite initial successes with source area removal and the pilot SVE system, additional efforts are needed to monitor and address the contaminated groundwater plume.

Data Review

The data included in the review for OU2 are a summary of the soil remedy progress and OU2 biannual groundwater monitoring to provide an overall understanding of the current extent of the PCE groundwater plume as pilot studies are ongoing. Details of the data are presented in Appendix H and summarized below.

Source Area Soil

Between July 2017 and October 2021, Soco excavated source areas soils at the five primary source areas (the Northwest Area, the Former Tank Farm Area, the Former Slope Pit Area and areas west of the Former Acid Tank Farm Area) (Figure G-1). Excavation in most areas met ROD cleanup goals. Several confirmatory soil samples exceed COC ROD cleanup goals in areas that could not be further excavated due to the presence of underground power lines. These areas will be addressed at a later date with another remedial technology.

Bi-Annual Groundwater Monitoring

PCE is the most widespread COC within OU2, while the breakdown products follow a similar pattern. Dissolved PCE concentrations detected in groundwater within the plume have historically been as high as 120,000 micrograms per liter (µg/L). The concentration was detected in 2002 at the OU2 Northwest Source Area in monitoring well PT-06. The October 2020 PCE groundwater concentration contour maps are shown downgradient of the source area (Figure G-2) and within the source area (Figure G-3). The PCE concentrations, while above cleanup goals, are much lower than observed in 2002 prior to initiation of the source remedies. Overall, analytical groundwater data during this FYR period indicate that COCs (as represented by PCE) continue to impact groundwater at OU2 (Figure G-4). Soco is currently conducting pilot studies to evaluate different technologies for addressing the source area groundwater concentrations, as discussed below.

Groundwater Pilot Studies

Soco operated the OS/VR system south of Coulson Ditch during the FYR reporting period. The analysis determined that a majority of the groundwater performance monitoring wells have similar concentrations to previous sampling events or indicate a general decline in COC concentrations (Figure G-5). This trend is represented by monitoring wells MW-410-I and MW-410-D (Figure G-5). A number of wells show fluctuations in various COC concentrations throughout the groundwater sampling events, as represented by MW-409-D and MW-413-D (Figure G-4). Soco will work with the EPA and MDEQ to reconstruct portions of the OS/VR system in soil excavation areas where a portion of the system had to be removed prior to soil excavation.

Soco has been conducting an enhanced bioremediation pilot study in an area of elevated groundwater contamination north of Coulson Ditch since Fall 2019. Soco injected EVO into a series of injection wells north of Coulson Ditch into the saturated alluvium. Quarterly sampling of the groundwater occurred following the March 2020 injections. A review of the quarterly sampling reports through October 2021 indicates post-injection decreases in PCE concentrations in several monitoring wells, coupled with the increases in cis-1,2-DCE concentrations (Table G-2) downgradient of and immediately adjacent to the enhanced bioremediation injection area. Soco continues to conduct post-injection monitoring to assess if the enhanced bioremediation remedial technology can effectively create a downgradient groundwater treatment barrier system to treat COC-impacted groundwater north of Coulson Ditch to below ROD cleanup goals and plans to expand the pilot test in 2022. In addition, a second round of injections commenced in May 2022 and was ongoing at the time this FYR Report was finalized. Expansion of the pilot test is also planned in 2022 once the spring 2022 flooded areas are dry enough.

Site Inspection

The site inspection took place on 8/18/2021. Participants included EPA RPM Roger Hoogerheide, MDEQ project manager Dick Sloan, PRP support contractor representative Jim Sullivan, and Ryan Burdge and Alison Cattani from EPA support contractor Skeo. The purpose of the inspection was to assess the protectiveness of the remedy. The site inspection checklist is included in Appendix E. Site inspection photographs are included in Appendix F.

Following a discussion of the current status of OU2 remedial actions, site inspection participants travelled to the OU2 source areas. There are signs on the front entrance gate, and the fence is in good condition. Participants observed the LTC, filled excavation areas and remaining excavation areas. No issues were noted with erosion or stormwater management. Observed monitoring wells were in good condition and locked. Participants then drove to the AJ Gravel Pond and along the residential area where vapor intrusion has been assessed. No issues were noted for OU2. The inspection ended by travelling to the OU1 source area and observed the property from outside the fence line to gain a general understanding of the proximity of OU1 to OU2 remedy components. Because the OU1 remedy has not yet been implemented, there were no remedy components to inspect.

V. TECHNICAL ASSESSMENT

QUESTION A: Is the remedy functioning as intended by the decision documents?

Question A Summary:

The PRP has initiated soil and groundwater remedial actions at OU2. The soil remedial actions completed by Soco are ongoing at the source areas. They include soil excavations at six areas, with the excavations phased to accommodate limited space for soil treatment. The excavations and treatment of contaminated soils in the LTC will continue until all six excavation areas within the source areas are completed – anticipated in 2024. The use of the LTC replaced the selected OU2 soil remedy component of low-temperature thermal treatment due to space limitations. The EPA will record this remedy modification in a decision document.

The groundwater remedial actions completed by Soco to date at OU2 include implementation of an OS/VR pilot scale test, which has been shown to be effective in treating impacted groundwater and secondarily soil in the northwest OU2 source area. In addition, Soco initiated an enhanced bioremediation pilot test to determine if the enhanced bioremediation remedial technology can create a downgradient groundwater treatment barrier system to

effectively treat COC-impacted groundwater to below the ROD cleanup goals north of Coulson Ditch. Preliminary results indicate a significant decrease in PCE concentrations in groundwater samples collected north of Coulson Ditch in the enhanced bioremediation pilot test area. However, recent groundwater observations indicate a stall in the degradation of DCE and VC to ethene; slow progress on bioremediation in some of the "D" wells; and low expansion of EB progress downgradient. Therefore, Soco has initiated a second round of EVO injections and plans to complete additional injection points and monitoring wells in 2022. If necessary, the EPA will modify the final remedy to record any remedy modifications implemented after the optimization assessment.

OU2 has not yet entered into the O&M phase, as cleanup activities are ongoing. The soil and groundwater remedies have not been fully constructed. However, in the interim, monitoring of the soil excavations and groundwater pilot study activities are ongoing.

Institutional controls are planned in the form of filing of deed restrictions to protect the final constructed engineered remedy components. In the interim, the PRP's contractor uses engineering controls such as fences and signs to prevent access to areas where remediation or pilot studies are occurring.

Sitewide Institutional Controls

The groundwater institutional controls required as outlined in the 2005 ROD were implemented in 2018 through the establishment of a permanent CGA that restricts groundwater use and installation of groundwater wells within the OU1 and OU2 groundwater plumes. Additional institutional controls are planned in the form of filing of deed restrictions to protect the final constructed engineered remedy components and development of a long-term community awareness/education program. This program is intended to inform the public of topics such as the health risks associated with the use of contaminated groundwater, the safe use of contaminated well water for certain purposes, measures to reduce the risks from contaminated vapors in indoor air, remedial components, construction and monitoring schedule, and potential impacts to the community. In the interim, at OU2 the PRP uses engineering controls to prevent access to areas where remediation or pilot studies are occurring. Current OU1 owners use engineering controls to prevent access to areas where remediation or pilot studies are occurring.

QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels and RAOs used at the time of the remedy selection still valid?

Question B Summary:

Exposure Assumptions
Since the 2005 ROD, the EPA has updated default exposure assumptions. However, these changes are not quantitatively significant because the cleanup levels for site COCs are based on drinking water maximum contaminant levels (MCLs) and leachability-based soil concentrations protective of groundwater at the MCL. In addition, another change in risk assessment methods has occurred since the ROD. A vapor intrusion pathway evaluation using multiple lines of evidence is now a part of the risk assessment methodology at sites where VOCs are present in the subsurface.

A sitewide VIA was completed as part of the 2005 ROD using soil, groundwater and indoor air samples. The EPA concluded at that time that vapor intrusion is a completed exposure pathway. However, the risks were within acceptable limits. This exposure pathway continues to be evaluated as more site sampling data become available.

The EPA completed a VIA at OU1 in 2013 by collecting shallow soil vapor samples and comparing them to indoor air RSLs. This FYR conducted a screening-level evaluation of the shallow soil vapor data that shows that potential residential-screening-level risks are within the EPA's risk range and below a noncancer hazard quotient of 1 (HQ of 1) (Table J-5). However, the screening-level evaluation shows TCE contributes to indoor air risks at the OU1 commercial facility above the noncancer threshold of 1.0 (Table J-6). This supports the need to address this exposure pathway with additional lines of evidence.

OU2 PRP contractors also completed a VIA in 2013 and another in 2021 based on multiple lines of evidence and current toxicity criteria focused on buildings expected to have the highest indoor air concentrations, which is the neighborhood north of Coulson Ditch. The 2021 evaluation demonstrates that COC vapors are migrating from groundwater and soil vertically through the subsurface. Only one of the five structures exceeded the carcinogenic-based indoor air RSL (Table J-7); however, the health risks are within the EPA's acceptable risk range and below the noncancer threshold of 1.0 (Table J-8). This exposure pathway will continue to be monitored to ensure the risks remain within acceptable limits as the remediation continues to reduce soil vapor and groundwater concentrations over time.

Applicable or Relevant and Appropriate Requirements (ARARs) and Toxicity Changes
There have been no changes to ARARs for the COCs (Appendix I). Since the 2005 ROD, carcinogenic toxicity criteria for TCE have become more stringent (e.g., more toxic) (Table J-1) and noncancer toxicity criteria have become more stringent for PCE and TCE (Table J-2). These changes do not affect the protectiveness of the groundwater remedy because the EPA selected the MCLs as the groundwater cleanup goals and the MCLs have not changed. However, it is important when evaluating the vapor intrusion exposure pathway that the most current inhalation toxicity values be used to reflect the more stringent values. A review of the most recent vapor intrusion study published in 2021 shows that the most-current toxicity values are being used to evaluate this exposure pathway.

The soil cleanup goals are based on leaching to groundwater. To determine if these soil cleanup goals are protective for unrestricted use, the OU1 and OU2 soil cleanup goals were compared to the EPA's residential RSLs (Table J-3 and Table J-4, respectively). The evaluation shows that the cleanup goals remain protective for residential use.

RAOs
Site RAOs remain valid. The RAOs of preventing human exposure to groundwater and surface water is addressed through institutional controls and monitoring. The groundwater and soil remedies are progressing toward reducing contaminant concentrations in the alluvial aquifer; modeling to date has demonstrated that groundwater is not impacting the Yellowstone River and the AJ Gravel property owner is filling in the gravel pit. The remedies are in the construction stage at OU2, and the remedies are still being designed for OU1. As remedial construction is completed at both OUs and long-term monitoring data become available, the progress of remedies toward achieving the RAOs will be addressed in future FYRs.

QUESTION C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that could call into question the protectiveness of the remedy.

VI. ISSUES/RECOMMENDATIONS

Issues/Recommendations	
OU(s) without Issues/Recommendations Identified in the FYR:	
None	
Issues and Recommendations Identified in the FYR:	
OU(s): OU2	**Issue Category: Institutional Controls**
	Issue: The implementation of a long-term community awareness and education program has not occurred prior to remedial construction activities at the Site as required by the 2005 site-wide ROD.

	Recommendation: Initiate a community awareness/education program to inform the public about the following topics: • Health risks associated with the use of contaminated groundwater. • Safe use of contaminated well water for certain purposes. • Measures to reduce the risks from contaminated vapors in indoor air. • Remedial components. • Construction and monitoring schedules and potential impacts on the community.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA	EPA/State	7/7/2025

OTHER FINDINGS

Additional recommendations were identified during the FYR. These recommendations do not affect current and/or future protectiveness.

- Consider documenting in a decision document the final remedies implemented at OU2 that may differ from those outlined in the 2005 ROD (e.g., low temperature thermal treatment was replaced with use of an LTC on site due to space limitations).
- Consider revising the OU boundaries to only encompass contaminated soil and groundwater.

VII. PROTECTIVENESS STATEMENT

Protectiveness Statement(s)	
Operable Unit: OU2	*Protectiveness Determination:* Will be Protective
Protectiveness Statement: The remedy at OU2 is expected to be protective of human health and the environment upon completion. In the interim, remedial activities completed to date have adequately addressed all exposure pathways that could result in unacceptable risks in the delineated areas. Soco is in the process of expanding the existing pilot test to treat COC-impacted groundwater north of Coulson Ditch.	

VIII. NEXT REVIEW

The next FYR Report for the Lockwood Solvent Groundwater Plume Superfund site is required five years from the completion date of this review.

APPENDIX A – REFERENCE LIST

Action Memorandum. Documentation of a Removal Action at the Lockwood Solvent Site in Billings, Yellowstone County, Montana. July 1999.

Action Memorandum First Amendment. Request for an Amendment to the Classic Emergency Removal Action at the Lockwood Solvent Site in Billings, Yellowstone County, Montana. January 2000.

Record of Decision, Lockwood Solvent Groundwater Plume Site, Billings, Montana. August 2005.

Vapor Intrusion Assessment Report – Operable Unit 1. Lockwood Solvent Groundwater Plume Site, Billings, Montana. Prepared by Pacific Western Technologies, Ltd. September 2013.

Optimization Review – Lockwood Operable Unit 1 – Beall Source Area. Lockwood Solvent Groundwater Plume Site. Billings, Montana. Prepared by EPA's Office of Solid Waste and Emergency Response Office of Superfund Remediation and Technology Innovation. September 2014.

Optimization Review – Lockwood Operable Unit 2 – Soco/Brenntag Source Area. Lockwood Solvent Groundwater Plume Site. Billings, Montana. Prepared by EPA's Office of Solid Waste and Emergency Response Office of Superfund Remediation and Technology Innovation. September 2014.

Vapor Intrusion Assessment Report – Operable Unit 2. Lockwood Solvent Groundwater Plume Site. Billings, Montana. Prepared by Cardno ATC. May 2015.

Notice of Adoption, Lockwood Solvent Groundwater Plume Site Controlled Groundwater Area. Department of Natural Resources and Conservation of the State of Montana. October 5, 2018.

Fine-Grained Source Soils Interim Remedial Action Completion Report No. 1. Operable Unit 2. Lockwood Solvent Groundwater Plume Site. Billings, Montana. Prepared by Tasman Geosciences, Inc. March 2019.

Annual Groundwater Monitoring Report - 2019. Operable Unit 2. Lockwood Solvent Groundwater Plume Site. Billings, Montana. Prepared by Tasman Geosciences, Inc. March 2020.

Fine-Grained Source Soils Interim Remedial Action Completion Report No. 2. Operable Unit 2. Lockwood Solvent Groundwater Plume Site. Billings, Montana. Prepared by Tasman Geosciences, Inc. March 2020

Action Memorandum Second Amendment. Request for an Amendment to the Classic Emergency Removal Action at the Lockwood Solvent Site in Billings, Yellowstone County, Montana. April 2000.

Administrative Settlement between the United States Environmental Protection Agency, State of Montana, MAC LTT, LLC and MAC LTT Manufacturing, Inc. December 3, 2020.

Enhanced In-Situ Bioremediation Pilot Test – OU1. Lockwood Solvent Groundwater Plume Superfund Site Yellowstone County, Montana. January 2021.

Soil Vapor Extraction System – 2020 Pilot Test Summary - Operable Unit 1 Source Area. Lockwood Solvent Groundwater Plume Site, Billings, Montana. Prepared by Pacific Western Technologies, Ltd. January 2021.

Enhanced Bioremediation Pilot Test Quarterly Report No. 4: October through December 2020. Operable Unit 2. Lockwood Solvent Groundwater Plume Site. Billings, Montana. Prepared by Tasman Geosciences, Inc. February 2021.

Public Meeting Presentation- Lockwood Solvents Groundwater Plume Site. Presentation by EPA Region 8. February 23, 2021.

Annual Groundwater Monitoring Report - 2020. Operable Unit 2. Lockwood Solvent Groundwater Plume Site. Billings, Montana. Prepared by Tasman Geosciences, Inc. March 2021.

Fine-Grained Source Soils Interim Remedial Action Completion Report No. 3. Operable Unit 2. Lockwood Solvent Groundwater Plume Site. Billings, Montana. Prepared by Tasman Geosciences, Inc. March 2021.

Monthly Progress Report #109 – June 2021. Operable Unit 2. Lockwood Solvent Groundwater Plume Site. Billings, Montana. Prepared by Tasman Geosciences, Inc. July 2021.

Enhanced Bioremediation Pilot Test Quarterly Report No. 6: April through June 2021. Operable Unit 2. Lockwood Solvent Groundwater Plume Site. Billings, Montana. Prepared by Tasman Geosciences, Inc. August 2021.

Vapor Intrusion Assessment Report – Operable Unit 2. Lockwood Solvent Groundwater Plume Site. Billings, Montana. Prepared by Tasman Geosciences, Inc. August 2021.

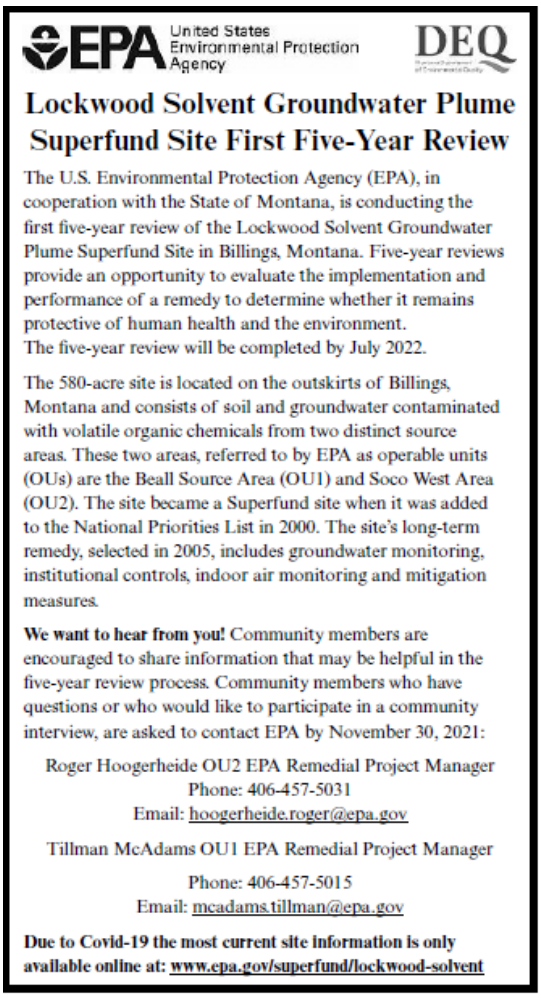
APPENDIX B – SITE CHRONOLOGY

Table B-1: Site Chronology

Event	Date
The MDEQ completed an initial assessment of the site contamination based on Lockwood Water and Sewer District personnel discovering chlorinated solvents in their water supply wells	June – September 1998
The MDEQ reported its findings to the EPA	January 31, 1999
The MDEQ and the EPA held a public meeting with the Lockwood community to report on recent investigations into groundwater contamination	May 12, 1999
The EPA initiated an emergency removal action, providing bottled water to affected residences where domestic water exceeded the state drinking water standards	July 13, 1999
The EPA requested an amendment to the emergency removal action to extend a water main to affected residences	January 27, 2000
The EPA requested a second amendment to the emergency removal action that documented the increased cost of extending the water main to affected residences	April 25, 2000
The EPA completed vapor intrusion mitigation in two homes	July 2000
The EPA completed an emergency removal action by extending the public water line to residences along Lomond Lane	August 2000
The MDEQ began the OU1 remedial investigation and feasibility study (RI/FS)	September 25, 2000
The EPA finalized the Site's listing on the NPL	December 1, 2000
PRP initiated a OU2 pilot test using OS and SVE to address soil and groundwater contamination	October 2004
The MDEQ completed the OU1 RI/FS The MDEQ and the EPA signed the ROD for OU1 and OU2	August 16, 2005
The EPA began the OU1 remedial design	April 21, 2011
The EPA issued an Administrative Order on Consent for the PRP to complete the OU2 remedial design PRP initiated the first OU2 remedial design for the OU2 groundwater and soil remedies	August 24, 2011
PRP entered into a Consent Decree with the EPA and the MDEQ to complete OU2 remedial design and remedial action activities	October 3, 2011
The EPA began a OU1 and OU2 remedial design optimization review	September 2012
The EPA completed a vapor intrusion evaluation at OU1	2013
PRP began additional source area delineation	July 2014
The EPA completed the OU1 and OU2 remedial design optimization reviews	September 19, 2014
PRP completed a vapor instruction assessment report for OU2	May 22, 2015
The EPA excavated contaminated source soil at OU1 near the new steam building and disposed of it off site at an approved landfill	July 2016
PRP completed source area delineation of contaminated soils	August 2016
PRP initiated the second OU2 remedial design for the groundwater remedy	February 2, 2017
The EPA excavated additional contaminated source soil and began construction of the OU1 SVE system	May 2017
PRP completed the first OU2 remedial design PRP initiated the soil OU2 remedial action at five source areas	July 7, 2017
PRP began expanding the OS/VR pilot test system near the Northwest Source Area	September 2017
PRP completed the second OU2 remedial design PRP initiated the groundwater OU2 remedial action	September 26, 2017
The EPA completed the construction of the OU1 SVE system	May 2018
PRP identified additional source soil contamination north of Coulson Ditch	November 2018
The EPA completed an SVE pilot test at OU1	February 2020
PRP began a pilot test of enhanced bioremediation at OU2 soils north of Coulson Ditch	March 2020
PRP began an enhanced bioremediation test at OU2 groundwater north of Coulson Ditch	August 2020
The EPA completed another ISB pilot test phase at OU1	October 2020
PRP conducted a follow-on vapor intrusion assessment at OU2	August 12, 2021
Major flooding by the Yellowstone River from rainfall and snowmelt	June 13, 2022

APPENDIX C – PRESS NOTICE

Published October 31, 2021 in the Billings Gazette



EPA United States Environmental Protection Agency

DEQ

Lockwood Solvent Groundwater Plume Superfund Site First Five-Year Review

The U.S. Environmental Protection Agency (EPA), in cooperation with the State of Montana, is conducting the first five-year review of the Lockwood Solvent Groundwater Plume Superfund Site in Billings, Montana. Five-year reviews provide an opportunity to evaluate the implementation and performance of a remedy to determine whether it remains protective of human health and the environment. The five-year review will be completed by July 2022.

The 580-acre site is located on the outskirts of Billings, Montana and consists of soil and groundwater contaminated with volatile organic chemicals from two distinct source areas. These two areas, referred to by EPA as operable units (OUs) are the Beall Source Area (OU1) and Soco West Area (OU2). The site became a Superfund site when it was added to the National Priorities List in 2000. The site's long-term remedy, selected in 2005, includes groundwater monitoring, institutional controls, indoor air monitoring and mitigation measures.

We want to hear from you! Community members are encouraged to share information that may be helpful in the five-year review process. Community members who have questions or who would like to participate in a community interview, are asked to contact EPA by November 30, 2021:

Roger Hoogerheide OU2 EPA Remedial Project Manager
Phone: 406-457-5031
Email: hoogerheide.roger@epa.gov

Tillman McAdams OU1 EPA Remedial Project Manager
Phone: 406-457-5015
Email: mcadams.tillman@epa.gov

Due to Covid-19 the most current site information is only available online at: www.epa.gov/superfund/lockwood-solvent

APPENDIX D – INTERVIEW FORMS

LOCKWOOD SOLVENT GROUNDWATER PLUME SUPERFUND SITE FIVE-YEAR REVIEW INTERVIEW FORM	
Site Name: LOCKWOOD SOLVENT GROUNDWATER PLUME	
EPA ID: MT0007623052	
Interviewer name: Ryan Burdge	**Interviewer affiliation: SKEO**
Subject name: Richard Sloan	**Subject affiliation: MTDEQ**
Subject contact information: 406-431-2582; rsloan@mt.gov	
Interview date:10/27/2021	**Interview time:10:00AM**
Interview location: Helena, MT	
Interview format (circle one): In Person Phone Mail Email Other:	
Interview category: State Agency	

1. What is your overall impression of the project, including cleanup, maintenance and reuse activities (as appropriate)?

   Note: OU1 is the former Beall trailers facility located at 1430 Highway 87 and is currently leased by MAC LTT. OU2 consists of the SOCO West facility (former Brenntag West Inc.) at 1353 Taylor Place. The facility is currently vacant. The OUs include contaminated soil on the property and contaminated ground water that flows North towards the Yellowstone River.

   OU1:
   The major sources of the chlorinated solvents (steam bay and local impacted soils) have been replaced. A pilot scale soil vapor extraction (SVE) system has operated intermittently on the local residual soils and ground water over the last several years with typical SVE performance – significant reduction of COCs followed by rebound when the SVE system is shut off. Limited monitoring of the chlorinated plume down gradient has not provided sufficient data to develop a path forward. The source area has been remediated, but little progress has been made on the down gradient plume. At the present time the property included in OU1 is fully utilized by a mix of residential, commercial, and light industrial activities.

   OU2:
   The responsible party, under the direction of EPA and DEQ, continues to make excellent progress remediating the source areas and the impacted ground water. The monthly progress reports and the focused reports clearly explain and track site activities and remedial progress. Source area fine grained soils are excavated and treated on-site in a soil treatment unit and then used as back fill when the ROD soil criteria are met. Enhanced bioremediation is being tested to remediate the down gradient plume. Regular ground water monitoring and reporting is tracking rapid remedial progress. Significant portions of OU2 could be ready for Commercial/industrial reuse in 2-3 years.

2. What is your assessment of the current performance of the remedy in place at the Site?

   OU1:
   Good progress on source control (steam bay and associated soils). Limited progress on evaluating remedial technologies for the down gradient chlorinated plume.

   OU2:

The PRP, under the direction of EPA and DEQ, has done an excellent job to remediate the chlorinated source areas and to evaluate and test technologies to remediate the ground water that has been impacted by the chlorinated solvents.

3. Are you aware of any complaints or inquiries regarding site-related environmental issues or remedial activities from residents in the past five years?

   OU1:
   The local water treatment district inquired as to possible soil and surface water impacts during the planned water treatment plant upgrade. Data was reviewed and surface water samples confirmed that the project was not impacted by the site. The purchaser of a local business property negotiated an agreement with the EPA and DEQ.

   OU2:
   The EPA, DEQ, and PRP have worked closely with local residents and businesses. There are currently no unresolved issues. A controlled ground water area was established by MTDNRC for most of the site (OU1 And OU2) to prevent the installation of additional ground water extraction wells. The Lockwood water and sewer district provides potable water to the residential and commercial properties in the area.

4. Has your office conducted any site-related activities or communications in the past five years? If so, please describe the purpose and results of these activities.

   OU1 and OU2:
   The EPA and DEQ have issued annual site public updates and held annual public meetings, most recently on February 22, 2021).

5. Are you aware of any changes to state laws that might affect the protectiveness of the Site's remedy?

   OU1 and OU2:
   I am not aware of any changes to state laws or regulations that could impact the protectiveness of the site remedy.

6. Are you comfortable with the status of the institutional controls at the Site? If not, what are the associated outstanding issues?

   OU1 and OU2:
   The only institutional control currently in place is the controlled ground water area (CGA), which was put into place through the authority of the Montana Department of Natural Resources and Conservation (MTDNRC). Additional institutional controls are currently not anticipated. The CGA is working as intended.

7. Are you aware of any changes in projected land use(s) at the Site?

   The current mix of residential, commercial, and light industrial is expected to continue.

8. Do you have any comments, suggestions or recommendations regarding the management or operation of the Site's remedy?

   DEQ recommends the following:

   OU1:
   - semi-annual ground water monitoring of down gradient wells to track the status and progress;
   - evaluating SVE rebound;
   - updating the SVE plan;

- designing and implementing enhanced in-situ bioremediation for the down gradient plume; and
- issuing quarterly OU1 status reports.

OU2:

- continuing excavation and treatment of fine-grained source area soils;
- continuing to operate the ozone sparge/vapor recovery system in specific source areas; and
- continuing to operate the enhanced in-site bioremediation system on the down gradient chlorinated plume.

9. Do you consent to have your name included along with your responses to this questionnaire in the FYR report?

   Please include my name and responses in the FYR report.

APPENDIX E – SITE INSPECTION CHECKLIST

FIVE-YEAR REVIEW SITE INSPECTION CHECKLIST

I. SITE INFORMATION

Site Name: Lockwood Solvent Groundwater Plume Superfund Site	**Date of Inspection:** 8/18/2021
Location and Region: Billings, Montana Region 8	**EPA ID: MTD053038386**
Agency, Office or Company Leading the Five-Year Review: The EPA	**Weather/Temperature:** 50s, sunny

Remedy Includes: (check all that apply)

- ☒ Landfill cover/containment (LTC)
- ☐ Access controls
- ☒ Institutional controls
- ☐ Groundwater pump and treatment (no longer active)
- ☐ Surface water collection and treatment
- ☒ Other: Soil vapor extraction, air sparging
- ☒ Monitored natural attenuation
- ☐ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ☒ Inspection team roster attached (see main report) ☐ Site map attached

II. INTERVIEWS (check all that apply)

1. **O&M Site Manager** _____ (Name) _____ (Title) _____ (Date)
   Interviewed ☐ at site ☐ at office ☐ by phone : _____
   Problems, suggestions ☐ Report attached: _____

2. **O&M Staff** _____ (Name) _____ (Title) _____ (Date)
   Interviewed ☐ at site ☐ at office ☐ by phone : _____
   Problems/suggestions ☐ Report attached: _____

3. **Local Regulatory Authorities and Response Agencies** (i.e., state and tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices). Fill in all that apply.

   Agency _____
   Contact _____ (Name) _____ (Title) _____ (Date) _____ (Phone No.)
   Problems/suggestions ☐ Report attached: _____

   Agency _____
   Contact _____Name _____ (Title) _____ (Date) _____ (Phone No.)
   Problems/suggestions ☐ Report attached:_____

   Agency _____
   Contact _____ (Name) _____ (Title) _____ (Date) _____ (Phone No.)
   Problems/suggestions ☐ Report attached:_____

   Agency _____
   Contact _____ (Name) _____ (Title) _____ (Date) _____ (Phone No.)
   Problems/suggestions ☐ Report attached: _____

Agency _____
Contact _____ _____ _____ _____
Name Title Date Phone No.
Problems/suggestions ☐ Report attached: _____

4. **Other Interviews** (optional) ☐ Report attached: _____

III. ON-SITE DOCUMENTS AND RECORDS VERIFIED (check all that apply)

1. **O&M Documents**

☐ O&M manual	☐ Readily available	☐ Up to date	☒ N/A
☐ As-built drawings	☐ Readily available	☐ Up to date	☒ N/A
☐ Maintenance logs	☐ Readily available	☐ Up to date	☒ N/A

Remarks: Site has not entered into O&M.

2.	**Site-Specific Health and Safety Plan**	☒ Readily available	☒ Up to date	☐ N/A
	☒ Contingency plan/emergency response plan	☒ Readily available	☒ Up to date	☐ N/A

Remarks: _____

3.	**O&M and OSHA Training Records**	☒ Readily available	☒ Up to date	☐ N/A

Remarks: _____

4. **Permits and Service Agreements**

☐ Air discharge permit	☐ Readily available	☐ Up to date	☒ N/A
☐ Effluent discharge	☐ Readily available	☐ Up to date	☒ N/A
☐ Waste disposal, POTW	☐ Readily available	☐ Up to date	☒ N/A
☐ Other permits: _____	☐ Readily available	☐ Up to date	☒ N/A

Remarks: _____

5.	**Gas Generation Records**	☐ Readily available	☐ Up to date	☒ N/A

Remarks: _____

6.	**Settlement Monument Records**	☐ Readily available	☐ Up to date	☒ N/A

Remarks: _____

7.	**Groundwater Monitoring Records**	☒ Readily available	☒ Up to date	☐ N/A

Remarks: _____

8.	**Leachate Extraction Records**	☐ Readily available	☐ Up to date	☒ N/A

Remarks: _____

9. **Discharge Compliance Records**

☐ Air	☐ Readily available	☐ Up to date	☒ N/A
☐ Water (effluent)	☐ Readily available	☐ Up to date	☒ N/A

Remarks: _____

10.	**Daily Access/Security Logs**	☒ Readily available	☒ Up to date	☐ N/A

Remarks: _____

IV. O&M COSTS

1. **O&M Organization**

☐ State in-house ☐ Contractor for state

☐ PRP in-house ☒ Contractor for PRP

☐ Federal facility in-house ☐ Contractor for Federal facility

☐ _____

2. **O&M Cost Records**

☐ Readily available ☐ Up to date

☐ Funding mechanism/agreement in place ☒ Unavailable

Original O&M cost estimate: _____ ☐ Breakdown attached

Total annual cost by year for review period if available

From: _____ Date	To: _____ Date	_____ Total cost	☐ Breakdown attached
From: _____ Date	To: _____ Date	_____ Total cost	☐ Breakdown attached
From: _____ Date	To: _____ Date	_____ Total cost	☐ Breakdown attached
From: _____ Date	To: _____ Date	_____ Total cost	☐ Breakdown attached
From: _____ Date	To: _____ Date	_____ Total cost	☐ Breakdown attached

3. **Unanticipated or Unusually High O&M Costs during Review Period**

Describe costs and reasons: _____

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. **Fencing Damaged** ☐ Location shown on site map ☒ Gates secured ☐ N/A

Remarks: _____

B. Other Access Restrictions

1. **Signs and Other Security Measures** ☐ Location shown on site map ☒ N/A

Remarks:

C. Institutional Controls (ICs)

1. **Implementation and Enforcement**

Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A

Site conditions imply ICs not being fully enforced ☐ Yes ☒ No ☐ N/A

Type of monitoring (e.g., self-reporting, drive by):

Frequency: _____

Responsible party/agency:

Contact _____ _____ _____ _____

Name Title Date Phone no.

Reporting is up to date ☐ Yes ☐ No ☒ N/A

Reports are verified by the lead agency ☐ Yes ☐ No ☒ N/A

Specific requirements in deed or decision documents have been met ☐ Yes ☒ No ☐ N/A

Violations have been reported ☐ Yes ☒ No ☐ N/A

Other problems or suggestions: ☐ Report attached

2. **Adequacy** ☐ ICs are adequate ☒ ICs are inadequate ☐ N/A

Remarks: Not all the ICs are in place. A controlled groundwater area has been established; however, deed restrictions have not yet been implemented. In the interim, engineering controls are in place to protect the remedy components.

D. General

1. **Vandalism/Trespassing** ☐ Location shown on site map ☒ No vandalism evident

Remarks: _____

2. **Land Use Changes On Site** ☒ N/A

Remarks: _____

3. **Land Use Changes Off Site** ☒ N/A

Remarks: _____

VI. GENERAL SITE CONDITIONS

A. Roads ☐ Applicable ☒ N/A

1. **Roads Damaged** ☐ Location shown on site map ☐ Roads adequate ☐ N/A

Remarks: _____

B. Other Site Conditions

Remarks: _____

VII. LANDFILL COVERS ☐ Applicable ☒ N/A

A. Landfill Surface

1. **Settlement** (low spots) ☐ Location shown on site map ☐ Settlement not evident

Area extent: _____ Depth: _____

Remarks: _____

2. **Cracks** ☐ Location shown on site map ☐ Cracking not evident

Lengths: _____ Widths: _____ Depths: _____

Remarks: _____

3. **Erosion** ☐ Location shown on site map ☐ Erosion not evident
Area extent: _____ Depth: _____
Remarks: _____

4. **Holes** ☐ Location shown on site map ☐ Holes not evident
Area extent: _____ Depth: _____
Remarks: _____

5. **Vegetative Cover** ☐ Grass ☐ Cover properly established
☐ No signs of stress ☐ Trees/shrubs (indicate size and locations on a diagram)
Remarks:

6. **Alternative Cover** (e.g., armored rock, concrete) ☐ N/A
Remarks: _____

7. **Bulges** ☐ Location shown on site map ☐ Bulges not evident
Area extent: _____ Height: _____
Remarks: _____

8. **Wet Areas/Water Damage** ☐ Wet areas/water damage not evident

☐ Wet areas ☐ Location shown on site map Area extent: _____
☐ Ponding ☐ Location shown on site map Area extent: _____
☐ Seeps ☐ Location shown on site map Area extent: _____
☐ Soft subgrade ☐ Location shown on site map Area extent: _____
Remarks: _____

9. **Slope Instability** ☐ Slides ☐ Location shown on site map
☐ No evidence of slope instability
Area extent: _____
Remarks: _____

B. Benches ☐ Applicable ☒ N/A
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

1. **Flows Bypass Bench** ☐ Location shown on site map ☐ N/A or okay
Remarks: _____

2. **Bench Breached** ☐ Location shown on site map ☐ N/A or okay
Remarks: _____

3. **Bench Overtopped** ☐ Location shown on site map ☐ N/A or okay
Remarks: _____

C. Letdown Channels ☐ Applicable ☒ N/A
(Channel lined with erosion control mats, riprap, grout bags or gabions that descend down the steep side

slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

1. **Settlement** (Low spots) ☐ Location shown on site map ☐ No evidence of settlement
   Area extent: _____ Depth: _____
   Remarks: _____

2. **Material Degradation** ☐ Location shown on site map ☐ No evidence of degradation
   Material type:_____ Area extent: _____
   Remarks: _____

3. **Erosion** ☐ Location shown on site map ☐ No evidence of erosion
   Area extent: _____ Depth: _____
   Remarks: _____

4. **Undercutting** ☐ Location shown on site map ☐ No evidence of undercutting
   Area extent: _____ Depth: _____
   Remarks: _____

5. **Obstructions** Type: _____ ☐ No obstructions
   ☐ Location shown on site map Area extent: _____
   Size: _____
   Remarks: _____

6. **Excessive Vegetative Growth** Type: _____
   ☐ No evidence of excessive growth
   ☐ Vegetation in channels does not obstruct flow
   ☐ Location shown on site map Area extent: _____
   Remarks: _____

D. Cover Penetrations ☐ Applicable ☒ N/A

1. **Gas Vents** ☐ Active ☐ Passive
   ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
   ☐ Evidence of leakage at penetration ☐ Needs maintenance ☐ N/A
   Remarks: _____

2. **Gas Monitoring Probes**
   ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
   ☐ Evidence of leakage at penetration ☐ Needs maintenance ☐ N/A
   Remarks: _____

3. **Monitoring Wells** (within surface area of landfill)
   ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
   ☐ Evidence of leakage at penetration ☐ Needs maintenance ☐ N/A
   Remarks: _____

4. **Extraction Wells Leachate**

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ Evidence of leakage at penetration ☐ Needs maintenance ☐ N/A

Remarks: _____

5. **Settlement Monuments** ☐ Located ☐ Routinely surveyed ☐ N/A

Remarks: _____

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

1. **Gas Treatment Facilities**

☐ Flaring ☐ Thermal destruction ☐ Collection for reuse

☐ Good condition ☐ Needs maintenance

Remarks: _____

2. **Gas Collection Wells, Manifolds and Piping**

☐ Good condition ☐ Needs maintenance

Remarks: _____

3. **Gas Monitoring Facilities** (e.g., gas monitoring of adjacent homes or buildings)

☐ Good condition ☐ Needs maintenance ☐ N/A

Remarks: _____

F. Cover Drainage Layer ☐ Applicable ☒ N/A

1. **Outlet Pipes Inspected** ☐ Functioning ☐ N/A

Remarks: _____

2. **Outlet Rock Inspected** ☐ Functioning ☐ N/A

Remarks: _____

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

1. **Siltation** Area extent: _____ Depth: _____ ☐ N/A

☐ Siltation not evident

Remarks: _____

2. **Erosion** Area extent: _____ Depth: _____

☐ Erosion not evident

Remarks: _____

3. **Outlet Works** ☐ Functioning ☐ N/A

Remarks: _____

4. **Dam** ☐ Functioning ☐ N/A

Remarks: _____

H. Retaining Walls ☐ Applicable ☒ N/A

1. **Deformations** ☐ Location shown on site map ☐ Deformation not evident

Horizontal displacement: _____ Vertical displacement: _____

Rotational displacement: _____

Remarks: _____

2. **Degradation** ☐ Location shown on site map ☐ Degradation not evident

Remarks: _____

I. Perimeter Ditches/Off-Site Discharge ☐ Applicable ☒ N/A

1. **Siltation** ☐ Location shown on site map ☐ Siltation not evident

Area extent: _____ Depth: _____

Remarks: _____

2. **Vegetative Growth** ☐ Location shown on site map ☐ N/A

☐ Vegetation does not impede flow

Area extent: _____ Type: _____

Remarks: _____

3. **Erosion** ☐ Location shown on site map ☐ Erosion not evident

Area extent: _____ Depth: _____

Remarks: _____

4. **Discharge Structure** ☐ Functioning ☐ N/A

Remarks: _____

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

1. **Settlement** ☐ Location shown on site map ☐ Settlement not evident

Area extent: _____ Depth: _____

Remarks: _____

2. **Performance Monitoring** Type of monitoring: _____

☐ Performance not monitored

Frequency: _____ ☐ Evidence of breaching

Head differential: _____

Remarks: _____

IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps and Pipelines ☐ Applicable ☒ N/A

1. **Pumps, Wellhead Plumbing and Electrical**

☐ Good condition ☐ All required wells properly operating ☐ Needs maintenance ☐ N/A

Remarks:

2. **Extraction System Pipelines, Valves, Valve Boxes and Other Appurtenances**

☐ Good condition ☐ Needs maintenance

Remarks: _____

3. **Spare Parts and Equipment**

☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided

Remarks: _____

B. Surface Water Collection Structures, Pumps and Pipelines ☐ Applicable ☒ N/A

1. **Collection Structures, Pumps and Electrical**

   ☐ Good condition ☐ Needs maintenance

   Remarks: _____

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes and Other Appurtenances**

   ☐ Good condition ☐ Needs maintenance

   Remarks: _____

3. **Spare Parts and Equipment**

   ☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided

   Remarks: _____

C. Treatment System ☐ Applicable ☒ N/A

1. **Treatment Train** (check components that apply)

   ☐ Metals removal ☐ Oil/water separation ☐ Bioremediation

   ☐ Air stripping ☐ Carbon adsorbers

   ☐ Filters: _____

   ☐ Additive (e.g., chelation agent, flocculent): _____

   ☐ Others: _____

   ☐ Good condition ☐ Needs maintenance

   ☐ Sampling ports properly marked and functional

   ☐ Sampling/maintenance log displayed and up to date

   ☐ Equipment properly identified

   ☐ Quantity of groundwater treated annually: _____

   ☐ Quantity of surface water treated annually: _____

   Remarks:

2. **Electrical Enclosures and Panels** (properly rated and functional)

   ☐ N/A ☐ Good condition ☐ Needs maintenance

   Remarks: _____

3. **Tanks, Vaults, Storage Vessels**

   ☐ N/A ☐ Good condition ☐ Proper secondary containment ☐ Needs maintenance

   Remarks: _____

4. **Discharge Structure and Appurtenances**

   ☐ N/A ☐ Good condition ☐ Needs maintenance

   Remarks: _____

5. **Treatment Building(s)**

   ☒ N/A ☐ Good condition (esp. roof and doorways) ☐ Needs repair

   ☐ Chemicals and equipment properly stored

   Remarks: _____

6. **Monitoring Wells** (pump and treatment remedy)

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ All required wells located ☐ Needs maintenance ☐ N/A

Remarks: _____

D. Monitoring Data

1. **Monitoring Data**

☒ Is routinely submitted on time ☒ Is of acceptable quality

2. **Monitoring Data Suggests:**

☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining

Remarks: The groundwater monitoring data for OU1 is not sufficient to determine the status of the chlorinated plume. The groundwater monitoring data for OU2 indicate that significant remedial progress is being made, but the ground water chlorinated plume is not effectively contained.

E. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)

☒ Properly secured/locked ☒ Functioning ☐ Routinely sampled ☒ Good condition

☐ All required wells located ☐ Needs maintenance ☐ N/A

Remarks: Monitored natural attenuation will not begin until source areas are remediated and groundwater treatment systems are in place.

X. OTHER REMEDIES

If there are remedies applied at the site and not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is designed to accomplish (e.g., to contain contaminant plume, minimize infiltration and gas emissions).

The OU1 and OU2 remedies are intended to treat soil and groundwater using a combination of technologies. Soil contamination is sourcing groundwater; thus, soil remediation was initiated first followed by groundwater treatment. Institutional controls are in place to prevent exposure to groundwater while engineering controls are in place to prevent exposures to soil to include fencing and existing pavement or asphalt.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

The remedy is not yet in the O&M phase.

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

None

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

The EPA completed optimitzation studies at both OUs in 2014 that supported the use of a combination of treatment technologies described in the 2005 ROD.

APPENDIX F – SITE INSPECTION PHOTOS

OU2 LTC

OU2 soil source area

OU2 soil source area

OU2 monitoring well

OU1 SVE system

OU1 source area property

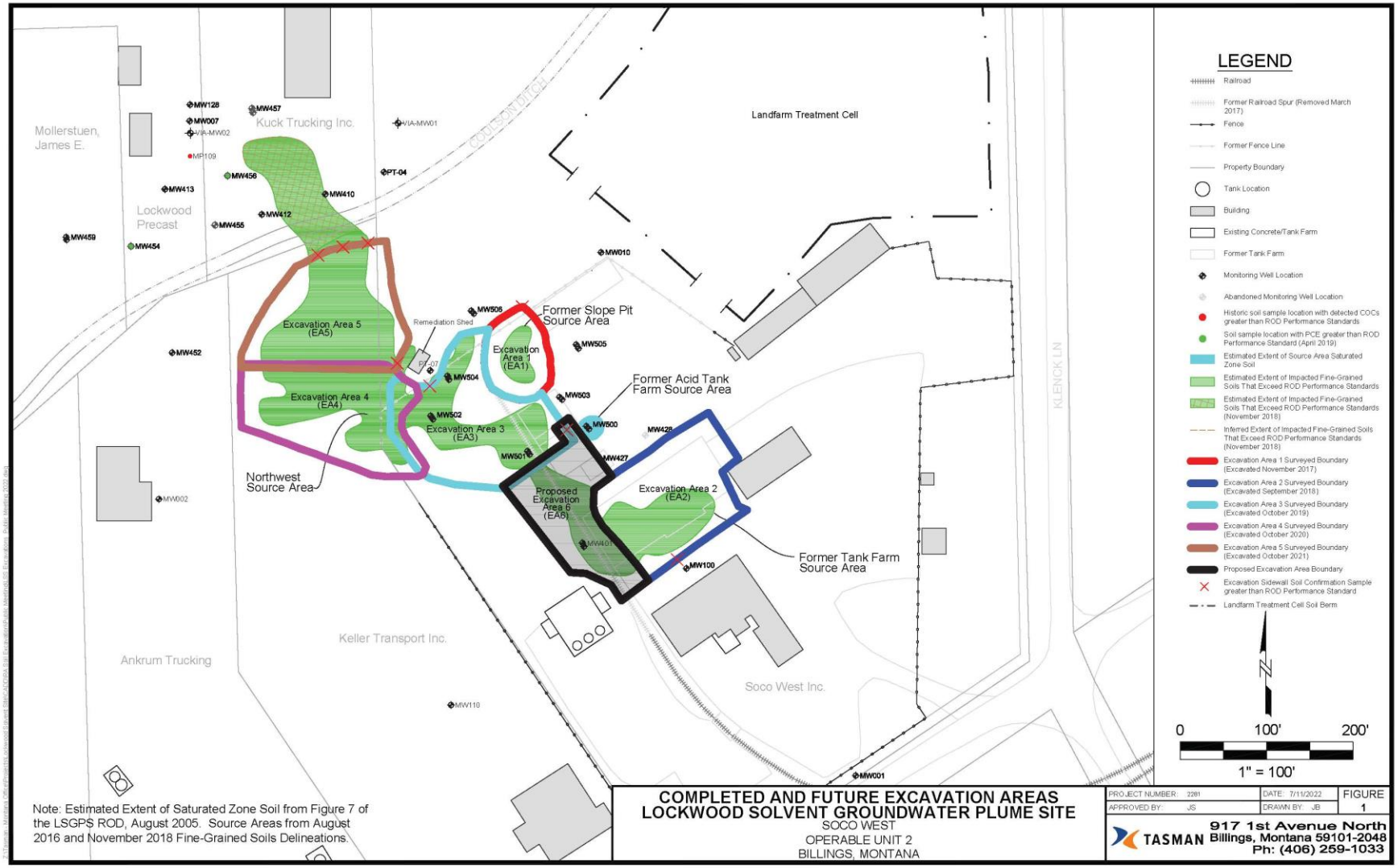
APPENDIX G –DETAILED DATA ANALYSIS

Source Area Soil

Between July 2017 and October 2020, Soco excavated source areas soils at the four primary source areas (the Northwest Area, the Former Tank Farm Area, the Former Slope Pit Area and an area west of the Former Acid Tank Farm Area) (Figure G-1). The depths of excavations ranged from about 10 feet bgs to 18 feet bgs or until groundwater was encountered. Sidewall soil confirmation samples (discrete grab soil samples) were collected approximately every 30 feet along the exterior perimeter of the excavation and submitted to the laboratory for VOC analysis.

Confirmation soil samples show cleanup level exceedances at three of the excavated areas (Table G-1). These areas will be addressed during subsequent excavations or with additional technologies if the soils are not accessible using excavation techniques. For example, there was one exceedance in the vicinity of an underground power line at the Former Slope Pit Area and another exceedance along the northern boundary of the Former Acid Tank Farm due to the proximity of the OS/VR system infrastructure, including the remediation shed. Soco completed the soil treatment of excavated soils from the Northwest Source Area in the LTC in June 2021. The PRP placed the treated soils meeting cleanup goals in a temporary stockpile on the Keller Transport property for future backfill in EA5.

Figure G-1: Completed and Future Soil Excavation Areas – OU2



Source: Tasman Geosciences, July 11, 2022.

Table G-1: Soil Excavation Side-Wall Confirmation Results Exceeding Cleanup Goals – OU2

Source Area	COC	ROD Cleanup Goal (mg/kg)	Concentration > ROD Cleanup Goal (mg/kg)	Confirmation Sample	Status
Former Slope Pit Area (EA1)	PCE	0.65	0.70	EX101-SS-7-8	Due to the underground power line, this exceedance on the northern portion of EA1 will be addressed at a later date.
West of Former Acid Tank Farm Area 3 (EA3)	PCE	0.65	15	EX311-SS-10	Located on the east sidewall of EA3, under the former acid tank farm. This will be addressed at a later date.
	Vinyl chloride	0.16	0.48		
	TCE	0.72	0.83 J	EX304-SS-14-15	The northern boundary of EA3 could not be excavated due to the proximity of the OS/VR system infrastructure, including the remediation shed. The area will either be excavated during a subsequent excavation or addressed with another remedial technology.
			1.4 J	EX305-SS-14-15 (duplicate)	
Northwest Source Area (located on Keller Transport Property) (EA4)	PCE	0.65	56	EX401-SS-9-10	Located on the northeast sidewall of the EA4, near the remediation shed. Additional excavation will be conducted along the northeast sidewall of EA4 when the southeast edge of EA5 is excavated.

Sources:

Fine-Grained Source Soils Interim Remedial Action Completion Report No. 1. Operable Unit 2. Lockwood Solvent Groundwater Plume Site. Billings, Montana. Prepared by Tasman Geosciences, Inc. March 2019.

Fine-Grained Source Soils Interim Remedial Action Completion Report No. 2. Operable Unit 2. Lockwood Solvent Groundwater Plume Site. Billings, Montana. Prepared by Tasman Geosciences, Inc. March 2020.

Fine-Grained Source Soils Interim Remedial Action Completion Report No. 3. Operable Unit 2. Lockwood Solvent Groundwater Plume Site. Billings, Montana. Prepared by Tasman Geosciences, Inc. March 2021.

Monthly Progress Report #109 – June 2021. Operable Unit 2. Lockwood Solvent Groundwater Plume Site. Billings, Montana. Prepared by Tasman Geosciences, Inc. July 2021.

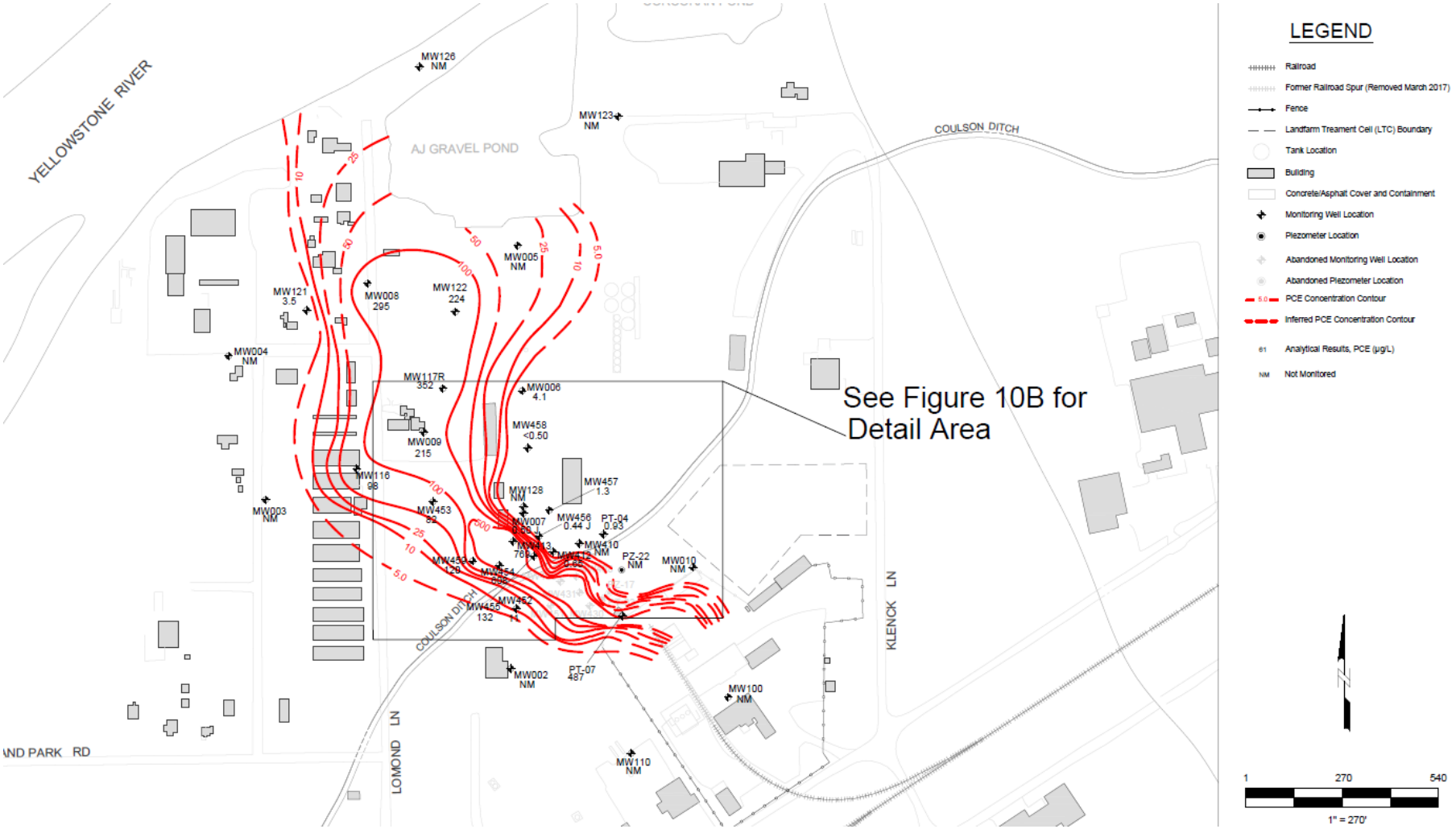
Bi-Annual Groundwater Monitoring

Soco completes bi-annual monitoring and summarizes findings in annual reports. The 2020 Annual Report includes the data for April (61 wells are sampled) and October 2020 (32 wells are sampled) as well as trends of concentrations over time. In addition, information obtained from the pilot test monitoring reports were reviewed to provide an overall understanding of the current extent of the PCE groundwater plume across OU2. PCE is the most widespread plume; the breakdown products follow a similar pattern of exceedances but are not as widespread.

The source of the groundwater plume is from COC impacts on soil. Groundwater flows northwest from the Soco property, ultimately discharging into the Yellowstone River. Dissolved PCE concentrations detected in groundwater within the plume have historically been as high as 120,000 µg/L. This concentration was detected in 2002 at the OU2 Northwest Source Area in monitoring well PT-06. This well was abandoned in August 2019 to facilitate soil excavation in the Northwest Source Area. However, the concentration in May 2019 was much lower than in 2002, with a PCE concentration of 39,700 µg/L. The October 2020 PCE groundwater concentration contour maps are shown downgradient of the source area (Figure G-2) and within the source areas (Figure G-3). The concentrations above cleanup goals are much lower than observed in 2002, prior to when source remedies were implemented. A majority of the wells downgradient of the source areas show a statistical decline in COC concentrations from 2002 to 2020, as exemplified by downgradient wells MW006, MW009 and MW116 (Figure G-4). However, within the source areas, COCs remain elevated above cleanup goals. As source areas continue to be remediated, the decline is expected to continue, as shown by the results of the source area pilot tests.

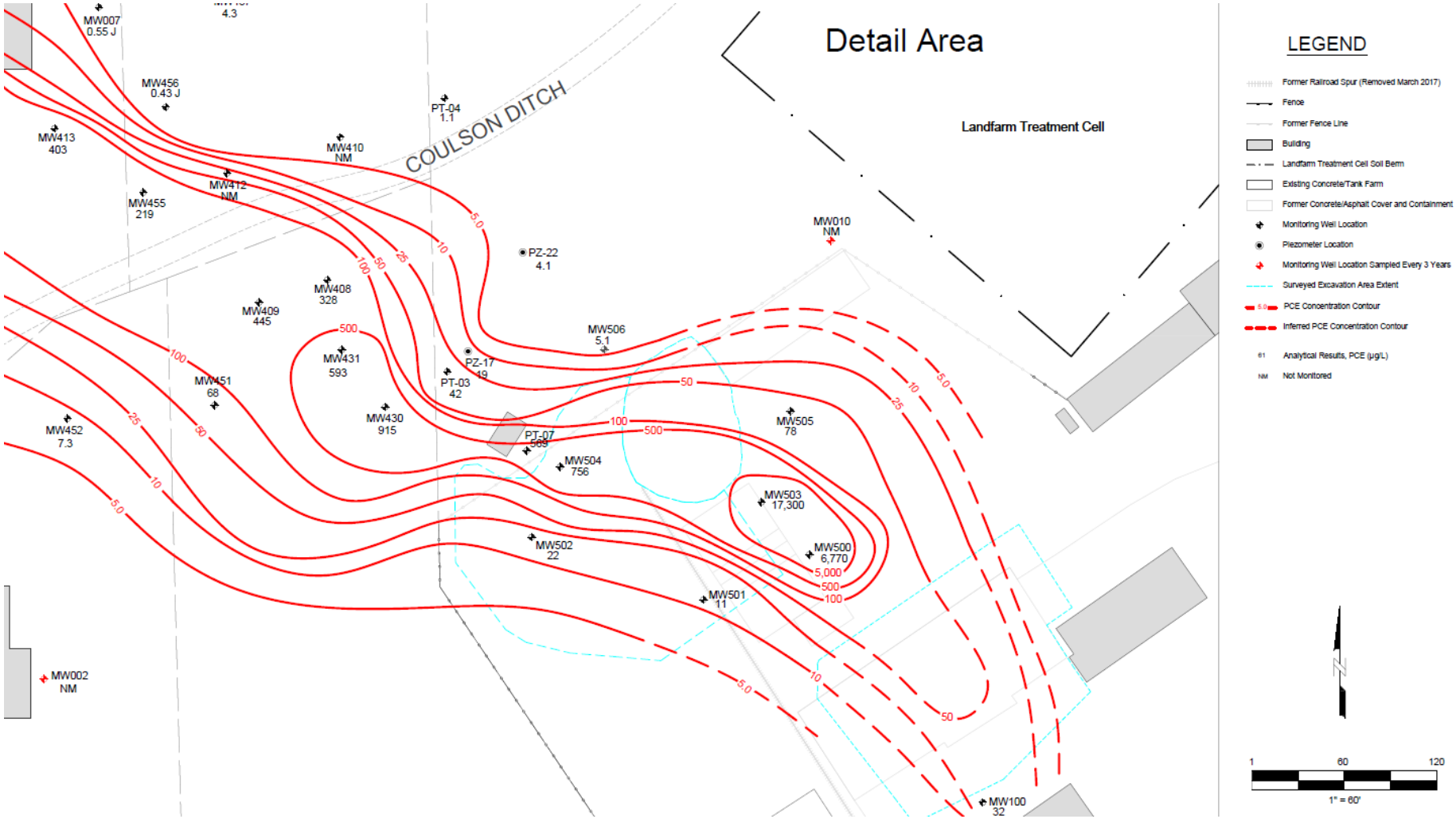
Analytical groundwater data during this FYR period indicate that COCs (as represented by PCE) continue to impact groundwater at OU2. Groundwater south of Coulson Ditch has higher COC concentrations due to the presence of source soils in this area (Figures G-2 and G-3). Soco is currently conducting pilot studies to evaluate different technologies for addressing the source area groundwater concentrations, as discussed below.

Figure G-2: PCE Plume, Deep Wells – OU2 (October 2020)



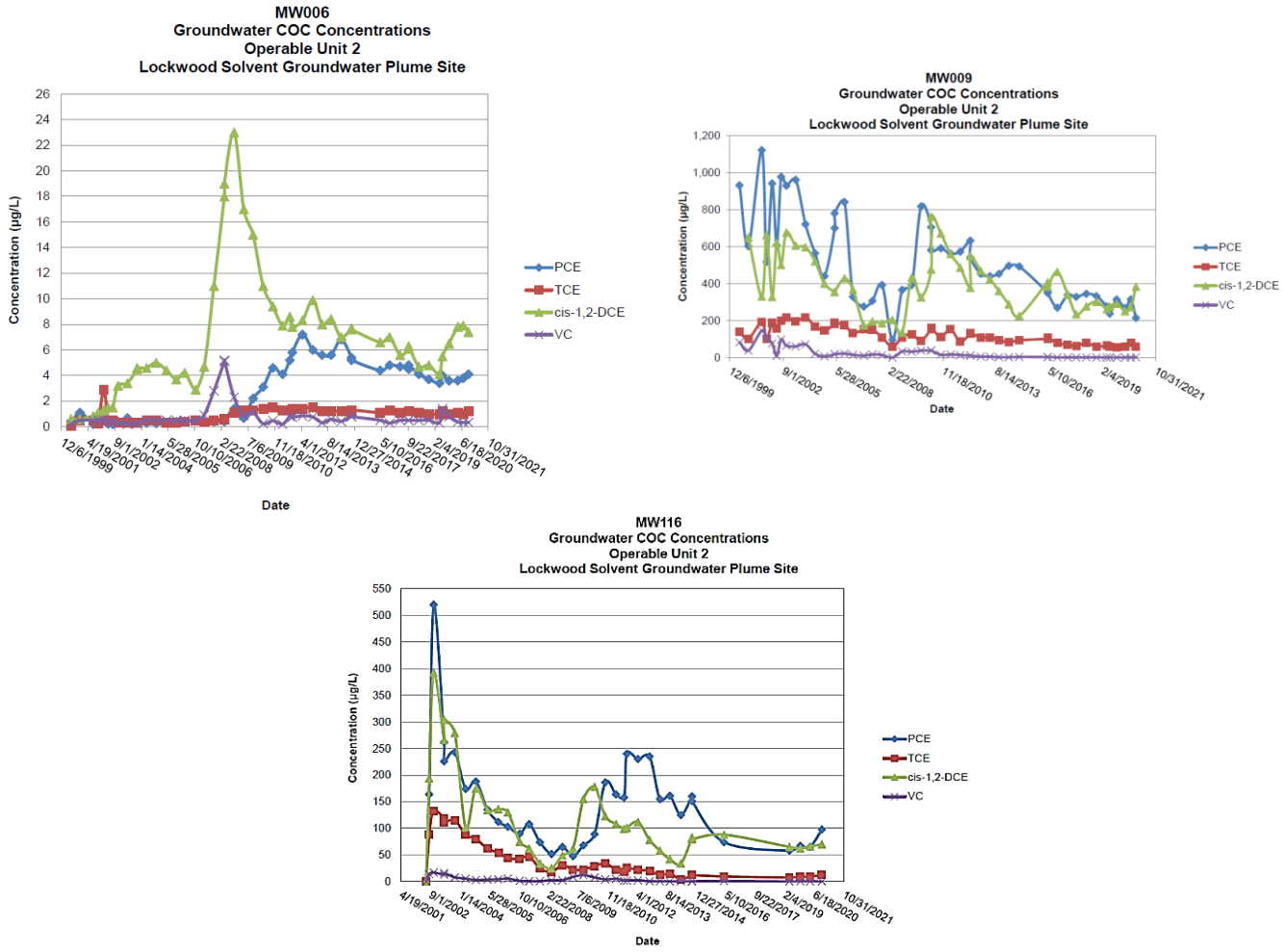
Source: Annual Groundwater Monitoring Report – 2020. Operable Unit 2. Lockwood Solvent Groundwater Plume Site. Billings, Montana. Prepared by Tasman Geosciences, Inc. March 2021.

Figure G-3: PCE Plume, Source Area Deep Wells – OU2 (October 2020)



Source: Annual Groundwater Monitoring Report – 2020. Operable Unit 2. Lockwood Solvent Groundwater Plume Site. Billings, Montana. Prepared by Tasman Geosciences, Inc. March 2021.

Figure G-4: Trend Graphs for Monitoring Wells MW006, MW009 and MW116

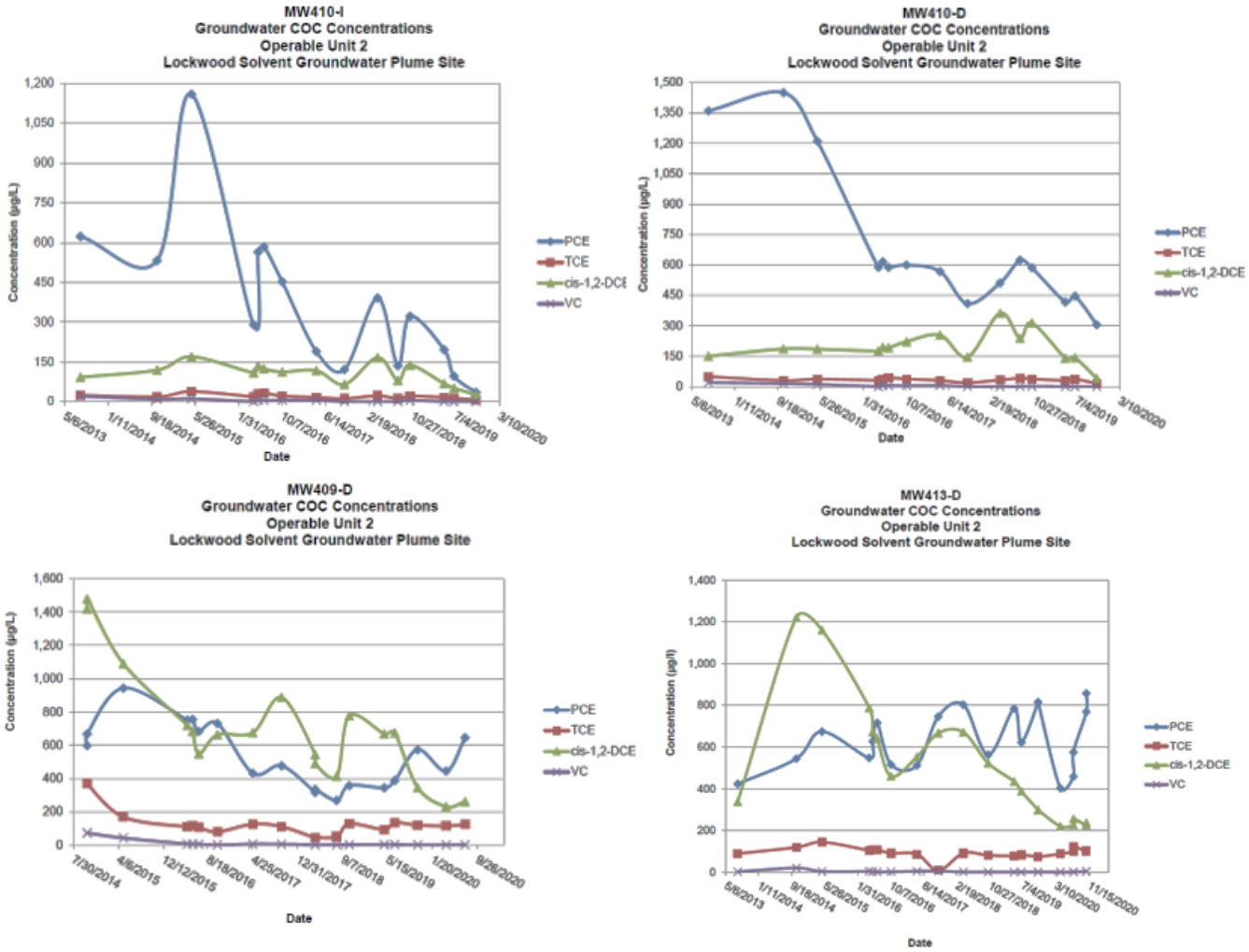


Source: Annual Groundwater Monitoring Report – 2020. Operable Unit 2. Lockwood Solvent Groundwater Plume Site. Billings, Montana. Prepared by Tasman Geosciences, Inc. March 2021.

OS/VR Pilot Test South of Coulson Ditch

In 2015, Soco implemented an OS/VR pilot scale test to initially treat the most-impacted groundwater within the Northwest Source Area, as designated by pilot test wells PT-02 (abandoned in 2017), -05 and -06 (abandoned in 2019). These wells were abandoned due to the need for soil remediation in these locations. Due to the success of the OS/VR system, Soco expanded the system to the west and north within the Northwest Source Area in September 2017 through the installation of additional pilot test wells. The pilot test performance monitoring network consists of over 30 piezometers and monitoring wells in the former tank farm area. Soco prepared trend graphs of OS/VR performance monitoring wells based on data collected between 2013 and 2020. The analysis determined that a majority of the groundwater performance monitoring wells have similar concentrations to previous sampling events or indicate a general decline in COC concentrations from 2013 to 2020. This trend is represented by monitoring wells MW-410-I and MW-410-D (Figure G-5). A number of wells show fluctuations in various COC concentrations throughout the groundwater sampling events, as represented by MW-409-D and MW-413-D (Figure G-5). Soco continues to work with the EPA to reconstruct portions of the OS/VR in soil excavation areas where a portion of the system had to be removed.

Figure G-5: Representative OS/VR Performance Well Trends



Source: Annual Groundwater Monitoring Report – 2020. Operable Unit 2. Lockwood Solvent Groundwater Plume Site. Billings, Montana. Prepared by Tasman Geosciences, Inc. March 2021.

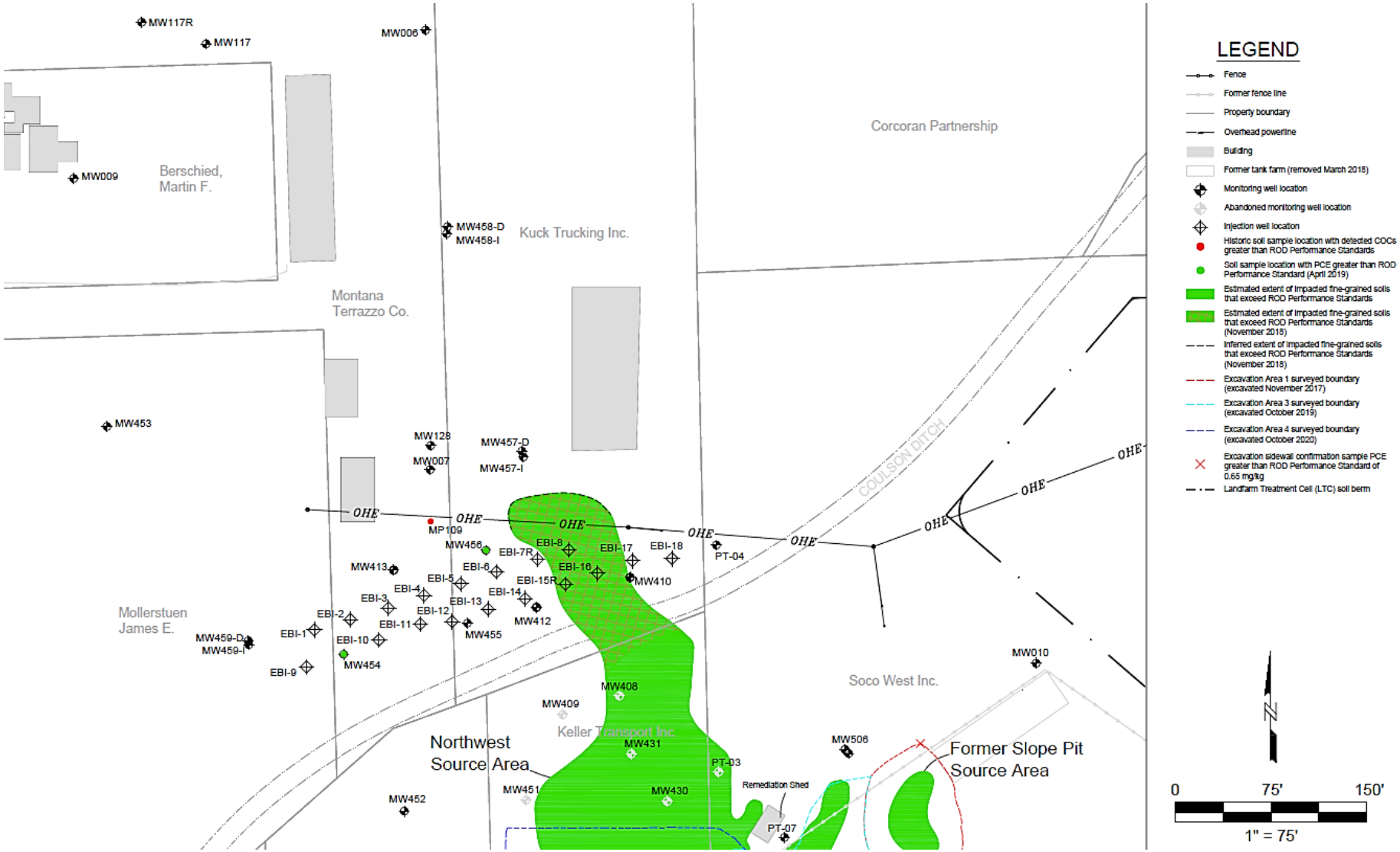
Enhanced Bioremediation Pilot Test North of Coulson Ditch

In 2017, Soco initiated a groundwater enhanced bioremediation pilot test to treat chlorinated solvent-impacted groundwater north of Coulson Ditch. From November 2019 through March 2020, Soco injected EVO into the saturated alluvium via a series of injection wells north of Coulson Ditch. Soco also injected the enriched bioaugmentation culture BAC-9 in August 2020. Figure G-6 shows the layout of the enhanced bioremediation infrastructure. Quarterly sampling of the groundwater occurred following the March 2020 injections. A review of the quarterly sampling reports through April 2021 indicates post-injection decreases in PCE concentrations in most monitoring wells, coupled with increases in cis-1,2-DCE concentrations. For example, the October 2019 PCE concentrations in monitoring wells MW412-I/D of 326 µg/L and 671 µg/L, respectively, were below the ROD cleanup goal of 5.0 µg/L in April 2021 (Table G-2). The decrease in PCE was coupled with an increase in cis-1,2-DCE concentrations, as listed in Table G-2, demonstrating that enhanced bioremediation is effective in breaking down PCE. Also, monitoring well MW007, which is located immediately downgradient of the enhanced bioremediation treatment area and had a pre-injection PCE concentration of 755 µg/L in October 2019, was below the ROD cleanup goal in April 2021 (Table G-2). The majority of the remaining monitoring wells sampled in April 2021 generally had COC concentrations similar to COC concentrations from the previous quarterly groundwater sampling event, except for monitoring wells MW454-I/D and MW459-I/D. Monitoring well MW454-I/D does not appear to be affected by the pilot test and MW459-I/D, located along the western boundary

of the enhanced bioremediation injection wells, had decreased PCE concentrations followed by a rebound in April 2021, as listed in Table G-2.

Overall, the pilot test data support that anaerobic biodegradation of the EVO and the reductive dechlorination of PCE is occurring in the enhanced bioremediation treatment area and the area immediately downgradient. Additionally, the injection of BAC-9 suggests that dechlorination of OU2 COCs to less-toxic compounds may be occurring over time. Soco continues to conduct post-injection monitoring to assess if the enhanced bioremediation remedial technology can effectively create a downgradient groundwater treatment barrier system to treat COC-impacted groundwater north of Coulson Ditch to below ROD cleanup goals.

Figure G-6: Location of Enhanced Bioremediation Injection Areas



Source: Enhanced Bioremediation Pilot Test Quarterly Report No. 4: October through December 2020. Operable Unit 2. Lockwood Solvent Groundwater Plume Site. Billings, Montana. Prepared by Tasman Geosciences, Inc. February 2021.

Table G-2: OU2 Downgradient Groundwater – Post Enhanced Bioremediation Injection Results

Well	Date	VOCs 8260B				Organics A5310C	Comments
		PCE (µg/L)	TCE (µg/L)	*cis*-1,2-DCE (µg/L)	VC (µg/L)	TOC (mg/L)	
		ROD Performance Standards					
		5.0	5.0	70	2.0	NSE	
MW006	4/30/2019	3.4	0.95	4.1	0.30 J	NS	Baseline
	6/25/2019	4.0	1.2	5.5	0.36	NS	Baseline
	10/28/2019	3.6	1.0	6.5	0.78	NS	
	4/8/2020	3.6	1.1	7.8	0.38 J	6.4	
	7/21/2020	3.8	1.0	7.9	0.32 J	6.2	
	10/27/2020	4.1	1.2	7.4	0.33 J	2.9	
	1/11/2021	4.4	1.1	6.8	0.25 J	2.8	
	4/27/2021	3.8	1.1	6.3	0.19 J	2.6	
MW007	4/29/2019	547	56	224	0.33 J	3.0	Baseline
	6/24/2019	476	49	202	0.23 J	NS	Baseline
	10/29/2019	755	63	126	0.21 J	NS	
	4/9/2020	0.55	3.5	842	0.81	39 D	Natural sample
	4/9/2020	< 5.0	3.8 J	872	< 5.0	40 D	Duplicate sample
	7/22/2020	1.4	6.9	708	5.7	34 D	
	10/28/2020	< 0.50	6.1	573	7.1	6 D	
	1/11/2021	0.42 J	5.6	521	15	4.1	
	4/28/2021	1.7	8.0	467	17	3.6	
MW009	4/30/2019	276	67	277	0.78	3.0	Baseline
	6/25/2019	237	61	291	0.81	NS	Baseline
	10/31/2019	314	55	251	0.41 J	NS	
	4/10/2020	267	59	273	0.63	8.2	
	7/24/2020	314	81	383	0.88	7.7	
	10/28/2020	215	60	386	1.9	3.5	
	1/13/2021	208	61	413	2.8	3.4	
	4/28/2021	176	55	324	4.1	3.1	
MW117	4/30/2019	95	10	51	1.1	NS	Baseline
	6/25/2019	51	8.2	42	1.3	NS	Baseline
	10/30/2019	80	12	40	0.83	NS	Replaced by MW117R in March 2020.
MW117R	4/8/2020	255	31	89	0.42 J	7.3	
	7/21/2020	307	49	281	1.7	8.7	Natural Sample
	7/21/2020	293	51	293	1.7	8.4	Duplicate Sample
	10/27/2020	352	69	519	3.8	4.4	
	1/11/2021	334	61	467	4.7	4.0	
	4/26/2021	244	48	359	6.4	3.4	

Well	Date	VOCs 8260B				Organics A5310C	Comments
		PCE (µg/L)	TCE (µg/L)	*cis* -1,2-DCE (µg/L)	VC (µg/L)	TOC (mg/L)	
		ROD Performance Standards					
		5.0	5.0	70	2.0	NSE	
MW408-I	4/29/2019	254	25	124	< 0.50	NS	Baseline
	6/26/2019	191	25	160	< 0.50	NS	Baseline
	11/1/2019	254	25	124	<0.50	NS	
	4/8/2020	182	19	37	<0.50	6.7	
	7/23/2020	481	42	81	0.84	6.8	Abandoned July 2020
MW408-D	4/29/2019	603	81	356	2.4	2.9	Baseline
	6/26/2019	252	116	213	5.1	NS	Baseline
	11/1/2019	131	99	141	4.5	NS	
	4/8/2020	328	60	87	1.5	6.2	
	7/23/2020	513	88	100	1.9	6.0	Abandoned July 2020
MW409-I	4/29/2019	384	31	200	< 0.50	NS	Baseline
	6/26/2019	310	34	156	< 0.50	NS	Baseline
	11/1/2019	353	28	108	< 0.50	NS	
	4/8/2020	332	26	87	< 0.50	7.6	Abandoned July 2020
MW409-D	4/29/2019	345	94	669	4.2	3.7	Baseline
	6/26/2019	388	135	675	3.7	NS	Baseline
	11/1/2019	574	120	346	2.2	NS	
	4/8/2020	445	115	232	1.4	6.6	
	7/23/2020	646	124	261	2.5	6.8	Abandoned July 2020
MW410-I	4/29/2019	196	16	68	< 0.50	NS	Baseline
	6/25/2019	96	13	51	0.23 J	NS	Baseline
	10/30/2019	35	7.2	26	< 0.50	NS	
	4/29/2021	0.91	0.63	213	12	209 D	
MW410-D	4/29/2019	417	30	141	< 0.50	3.1	Baseline
	6/25/2019	446	37	142	< 0.50	NS	Baseline
	10/30/2019	305	15	40	0.47 J	NS	Served as injection well for EBI-17.
	4/29/2021	0.59	6.8	189	12	323 D	
MW412-I	4/30/2019	245	19	134	< 0.50	NS	Natural sample. Baseline
	4/30/2019	275	19	144	< 0.50	NS	Duplicate sample. Baseline
	6/25/2019	275	25	132	< 0.50	NS	Natural sample. Baseline
	6/25/2019	256	23	126	< 0.50	NS	Duplicate sample. Baseline
	10/30/2019	326	28	81	0.17 J	NS	Served as injection well for EBI-14.
	10/29/2020	0.95	5.7	250	13	222 D	
	1/12/2021	0.83	6.8	224	14	310 D	
	4/29/2021	1.4	2.5	152	3.2	151 D	
MW412-D	4/29/2019	577	37	181	0.40 J	NS	Baseline
	6/25/2019	564	40	181	0.43 J	NS	Baseline
	10/30/2019	671	45	106	0.50 J	NS	Served as injection well for EBI-14.
	10/29/2020	0.65	6.2	432	28	188 D	
	1/12/2021	2.2	5.0	492	19	143 D	
	4/29/2021	2.9	6.5	413	7.2	168 D	

Well	Date	VOCs 8260B				Organics A5310C	Comments
		PCE (µg/L)	TCE (µg/L)	*cis*-1,2-DCE (µg/L)	VC (µg/L)	TOC (mg/L)	
		ROD Performance Standards					
		5.0	5.0	70	2.0	NSE	
MW413-I	4/30/2019	450	42	251	< 0.50	NS	Baseline
	6/24/2019	345	40	232	0.20 J	NS	Baseline
	10/29/2019	477	46	180	0.34 J	NS	
	4/15/2020	13	8.7	441	28	86 D	
	7/22/2020	11	6.0	388	17	19.4	
	10/28/2020	48	47	287	59	6 D	
	1/12/2021	26	21	146	33	5 D	
	4/29/2021	39	16	95	16	4.1	
MW413-D	4/30/2019	784	78	435	1.0	2.9	Baseline
	6/24/2019	622	83	388	0.71	NS	Baseline
	10/29/2019	815	73	298	0.92	NS	Natural sample
	10/29/2019	793	77	296	0.97	NS	Duplicate sample
	4/14/2020	403	88	220	0.53	3.3	
	7/22/2020	458	100	227	0.68 J	6.3	Natural sample
	7/22/2020	575	124	256	0.94 J	6.3	Duplicate sample
	10/28/2020	769	99	225	3.8	3.4	Natural sample
	10/28/2020	857	104	237	3.6	3.4	Duplicate sample
	1/12/2021	734	103	354	4.3	3.5	
	4/29/2021	458	94	292	3.4	3.3	
MW451-I	4/29/2019	73	6.7	40	< 0.50	NS	Baseline
	6/26/2019	60	8.1	31	< 0.50	NS	Baseline
	11/1/2019	98	10	148	4.2	NS	
	4/15/2020	38	7.4	90	1.3	2.8	
	7/23/2020	120	8.3	60	0.32 J	6.3	Abandoned July 2020
MW451-D	4/29/2019	195	13	94	< 0.50	2.6	Baseline
	6/26/2019	138	13	60	< 5.0[A]	NS	Baseline
	11/1/2019	167	14	217	6.8	6.2	
	4/15/2020	68	10	102	1.3	2.8	
	7/23/2020	157	11	98	1.0	6.6	Abandoned July 2020
MW452-I	4/25/2019	17	3.0	5.8	< 0.50	NS	Baseline
	6/26/2019	12	3.7	3.3	< 0.50	NS	Baseline
	10/31/2019	11	4.2	21	0.99 J	NS	Natural sample
	10/31/2019	11	4.8	24	1.4 J	NS	Duplicate sample
	4/15/2020	5.8	3.3	14	0.25 J	2.5	
	7/23/2020	5.8	3.9	5.9	< 0.50	6.2	
	10/29/2020	5.5	3.9	5.9	0.47 J	2.8	
	1/13/2021	3.3	3.2	5.7	< 0.50	2.7	
	4/27/2021	2.8	3.1	2.4	< 0.50	2.5	
MW452-D	4/25/2019	25	3.8	6.0	< 0.50	NS	Natural sample. Baseline
	4/25/2019	23	4.0	6.4	< 0.50	NS	Duplicate sample. Baseline
	6/26/2019	17	3.9	3.6	< 0.50	NS	Baseline
	10/31/2019	16	4.8	30	1.9	NS	
	4/15/2020	7.3	3.5	16	0.48 J	2.5	
	7/23/2020	8.1	4.1	8.7	< 0.50	6.3	
	10/29/2020	11	4.1	9.1	0.59	2.8	
	1/13/2021	7.3	3.7	9.3	0.36 J	2.7	
	4/27/2021	5.4	3.5	4.4	< 0.50	2.5	
MW453-I	5/1/2019	376	35	325	< 5.0[A]	NS	Baseline
	6/26/2019	387	46	280	< 5.0[A]	NS	Baseline
	4/13/2020	143	49	719	0.71	9.3	
	7/21/2020	143	29	491	3.0	8.1	
	10/27/2020	119	26	319	2.4	3.5	
	1/13/2021	73	20	288	4.4	3.3	
	4/28/2021	74	24	353	5.5	3.0	

Well	Date	VOCs 8260B				Organics A5310C	Comments
		PCE (µg/L)	TCE (µg/L)	*cis*-1,2-DCE (µg/L)	VC (µg/L)	TOC (mg/L)	
		ROD Performance Standards					
		5.0	5.0	70	2.0	NSE	
MW453-D	5/1/2019	386	37	365	< 5.0[A]	NS	Baseline
	6/26/2019	401	48	308	< 5.0[A]	NS	Baseline
	4/13/2020	50	30	734	0.84	10.2	
	7/21/2020	113	32	532	3.1	7.9	
	10/27/2020	82	22	330	3.1	3.5	
	1/13/2021	64	20	332	6.3	3.4	
	4/28/2021	57	20	355	5.5	3.1	
MW454-I	5/2/2019	380	19	144	< 0.50	NS	Baseline
	6/24/2019	333	19	117	< 0.50	NS	Baseline
	10/29/2019	374	25	130	1.0	NS	
	4/14/2020	361	25	97	< 0.50	3.1	
	7/22/2020	417	31	90	0.55	6.2	
	10/28/2020	858	36	111	2.6	3.5	
	1/12/2021	715	35	129	3.1	3.3	
	4/28/2021	449	28	118	1.9	3.0	
MW454-D	5/2/2019	365	22	156	0.26 J	3.2	Baseline
	6/24/2019	208	16	135	0.40 J	NS	Natural sample. Baseline
	6/24/2019	226	20	135	0.38 J	NS	Duplicate sample. Baseline
	10/29/2019	361	25	154	0.98	NS	
	4/14/2020	307	22	98	< 0.50	3.0	
	7/22/2020	369	29	103	0.63	6.3	
	10/28/2020	608	32	111	2.4	3.3	
	1/12/2021	420	28	123	1.8	3.3	
	4/28/2021	371	29	120	1.5	3.0	Natural sample
	4/28/2021	411	31	130	1.3	2.9	Duplicate sample
MW455-I	5/2/2019	261	27	112	0.79	NS	Baseline
	6/24/2019	69	143	259	1.1	NS	Baseline
	10/29/2019	171	42	326	0.30 J	NS	
	4/10/2020	0.42 J	5.7	489	10	212.0 D	
	7/22/2020	0.79	6.8	523	12	116.0 D	
	10/29/2020	0.24 J	1.7	438	19	46 D	
	1/12/2021	2.6	4.5	398	41	14 D	
	4/29/2021	4.3	3.1	307	49	15.8	
MW455-D	5/2/2019	486	64	287	4.3	3.8	Baseline
	6/24/2019	109	195	263	3.4	NS	Baseline
	10/29/2019	124	185	315	0.66	NS	
	4/9/2020	219	78	131	< 0.50	7.6	
	7/22/2020	126	51	302	0.29 J	6.4	
	10/29/2020	132	112	226	0.83	3.8	
	1/12/2021	193	112	158	0.41 J	4.1	Natural sample
	1/12/2021	231	120	155	0.50 J	3.8	Duplicate sample
	4/29/2021	205	134	123	0.31 J	3.7	

Well	Date	VOCs 8260B				Organics A5310C	Comments
		PCE (µg/L)	TCE (µg/L)	*cis*-1,2-DCE (µg/L)	VC (µg/L)	TOC (mg/L)	
		ROD Performance Standards					
		5.0	5.0	70	2.0	NSE	
MW456-I	5/2/2019	327	48	114	1.5	NS	Baseline
	6/25/2019	163	225	114	1.6	NS	Baseline
	10/30/2019	201	108	105	0.27 J	NS	
	4/10/2020	12	60	337	0.9	30 D	
	7/22/2020	4.2	73	502	7.1	16.8	
	10/28/2020	0.70	25	458	4.4	7 D	
	1/11/2021	0.57	13	367	15	5.7	
	4/29/2021	0.56	7.2	348	16	5.1	
MW456-D	5/2/2019	370	96	174	3.1	3.3	Baseline
	6/25/2019	157	352	177	2.6	NS	Baseline
	10/30/2019	440	119	156	0.44 J	NS	
	4/9/2020	0.43 J	8.4	1,030	1.1	41 D	
	7/22/2020	0.66	2.6	1,070	5.4	76 D	
	10/28/2020	0.44 J	3.1	666	33	7.7	
	1/11/2021	0.55	15	362	47	3.7	
	4/29/2021	< 0.50	2.2	254	30	3.8	
MW457-I	5/2/2019	59	10	62	1.5	NS	Natural sample. Baseline
	5/2/2019	72	11	74	1.6	NS	Duplicate sample. Baseline
	6/24/2019	19	5.3	36	1.7	NS	Baseline
	10/30/2019	16	4.5	17	0.29 J	NS	
	4/14/2020	10	5.0	19	0.42 J	3.2	
	7/21/2020	9.6	5.3	21	0.52	6.6	
	10/28/2020	11	5.8	20	0.48 J	3.1	
	1/11/2021	10	4.0	14	0.43 J	3.0	
	4/27/2021	9.9	4.4	18	0.65	2.9	
MW457-D	5/2/2019	31	22	27	0.26 J	1.8	Baseline
	6/24/2019	28	25	31	< 0.50	NS	Baseline
	10/30/2019	59	17	21	0.21 J	NS	
	4/14/2020	4.3	10	197	< 0.50	30 D	
	7/21/2020	0.84	4.2	132	0.44 J	7.8	
	10/28/2020	1.3	5.2	115	5.6	3 D	
	1/11/2021	1.4	6.7	117	7.5	2.7	
	4/27/2021	0.78	5.8	62	2.7	2.5	
MW458-I	5/2/2019	262	64	171	0.96	NS	Baseline
	6/24/2019	183	48	138	1.6	NS	Baseline
	10/29/2019	197	38	61	1.0	NS	Natural sample
	10/29/2019	198	39	61	1.1	NS	Duplicate sample
	4/14/2020	125	23	70	0.61	3.4	
	7/21/2020	71	80	563	2.9	10.3	
	10/27/2020	97	103	378	5.7	4.1	
	1/11/2021	85	76	244	3.7	3.8	
	4/27/2021	74	47	198	3.3	3.4	
MW458-D	5/2/2019	0.47 J	7.6	21	0.81	2.2	Baseline
	6/24/2019	< 0.50	1.6	23	0.62	NS	Baseline
	10/29/2019	0.57	1.4	8.3	< 0.50	NS	
	4/13/2020	0.43 J	0.64	6.6	< 0.50	9.2	
	7/21/2020	< 0.50	0.45 J	6.6	< 0.50	8.5	
	10/27/2020	< 0.50	0.50 J	14	< 0.50	2.1	
	1/11/2021	0.24 J	0.71	14	0.18 J	2.3	
	4/27/2021	0.17 J	0.21 J	7.7	0.28 J	1.8	

Well	Date	VOCs 8260B				Organics A5310C	Comments
		PCE (µg/L)	TCE (µg/L)	*cis*-1,2-DCE (µg/L)	VC (µg/L)	TOC (mg/L)	
		ROD Performance Standards					
		5.0	5.0	70	2.0	NSE	
MW459-I	8/12/2019	96	11	48	< 1.0	NS	Baseline
	10/29/2019	128	14	87	0.74	NS	
	4/13/2020	34	18	155	1.9	14.8	
	7/24/2020	55	17	169	1.4	8.4	
	10/28/2020	103	20	165	1.8	3.6	
	1/13/2021	93	15	122	2.2	3.2	Natural sample
	1/13/2021	99	16	120	2.1	3.1	Duplicate sample
	4/28/2021	64	9.7	97	1.3	2.9	
MW459-D	8/12/2019	98	80	145	1.8	NS	Natural sample. Baseline
	8/12/2019	110	80	142	1.8	NS	Duplicate sample. Baseline
	10/29/2019	137	79	168	1.7	NS	
	4/13/2020	61	90	187	1.3	6.9	
	7/24/2020	71	94	182	1.1	6.2	
	10/28/2020	120	89	194	2.0	3.1	
	1/13/2021	125	100	176	2.2	2.8	
	4/28/2021	101	113	178	1.6	2.7	
PT-04	4/30/2019	0.31 J	0.42 J	8.4	0.75	< 40 D	Baseline
	6/25/2019	< 0.50	0.22 J	4.3	0.34 J	NS	Baseline
	10/30/2019	0.95	1.1	9.8	0.42 J	NS	
	4/10/2020	1.1	1.1	5.0	< 0.50	7.9	
	7/24/2020	0.66	0.71	3.3	< 0.50	7.8	
	10/29/2020	0.93	0.84	3.6	< 0.50	2.8	
	1/12/2021	1.3	1.2	4.2	0.26 J	2.8	
	4/27/2021	2.0	1.6	5.7	0.30 J	2.6	
EBI-9	8/12/2019	171	35	72	< 1.0	NS	Baseline

Notes:

[A] - The reporting limit reflects a five times dilution. The sample was diluted due to sample matrix interference.

D - Reporting limit increased due to sample matrix.

J - Estimated value. Result outside QA/QC limits.

NS - Not Sampled.

NSE - No standard established.

ROD Performance Standards - Applicable cleanup levels for groundwater, as set forth in the August 2005 Record of Decision for the Lockwood Groundwater Solvent Plume Site.

TOC - Total organic carbon.

In January 2020 due to daylighting issues, EVO solution was injected into monitoring wells MW410-D and MW412-I/-D which served as the completed injections for EB injection wells EBI-17 and EBI-14, respectively.

Bold - Indicates that analyte concentration equals or exceeds the ROD Performance Standards.

VC – Vinyl Chloride

Source: Enhanced Bioremediation Pilot Test Quarterly Report No. 6: April through June 2021. Operable Unit 2. Lockwood Solvent Groundwater Plume Site. Billings, Montana. Prepared by Tasman Geosciences, Inc. August 2021.

APPENDIX H – DETAILED ARARS REVIEW TABLES

Remedial actions are required to comply with the ARARs identified in the ROD. In performing the FYR any newly promulgated standards, including revised chemical-specific requirements (such as MCLs and ambient water quality criteria), revised action- and location-specific requirements, and state of Montana standards (if they were considered ARARs in the ROD), are reviewed to establish whether the new requirement indicates that the remedy is no longer protective. The 2005 ROD included a comprehensive list of chemical-specific, location-specific and action-specific ARARs in Appendix B. The ARARs review for this first FYR was focused on the chemical-specific ARARs used in evaluating the progress of the ongoing implementation of the soil and groundwater/surface water remedies.

The EPA and the MDEQ established the OU1 and OU2 groundwater and surface water cleanup levels in the 2005 ROD. The Agencies selected federal MCLs as the cleanup levels for both groundwater and surface water based on the national primary drinking water regulations (40 CFR 141), which have also been incorporated into state law. Table H-1 shows that the groundwater and surface water cleanup levels for the ARAR-based levels have not changed.

Table H-1: Site-wide Groundwater/Surface Water ARARs Review

COC	2005 Groundwater/Surface Water Cleanup Level (µg/L)	Current Federal MCL[a] (µg/L)	Current State Standard[b] (µg/L)	Change
PCE	5	5	5	None
TCE	5	5	5	None
Cis-1,2-DCE	70	70	70	None
Vinyl chloride	2[c]	2	0.2	None

Notes:

a. Federal MCLs available at https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulations (accessed 8/9/2021).

b. Montana Standards for groundwater available at https://deq.mt.gov/files/Water/WQPB/Standards/PDF/DEQ7/DEQ-7.pdf (accessed 8/9/2021).

c. The 2005 ROD identified a surface-water state ARAR of 0.2 µg/L but selected the MCL as the final cleanup goal. The 2005 ROD indicated that site-specific surface water criteria may be developed if warranted for the Yellowstone River.

µg/L = micrograms per liter

APPENDIX I – QUESTION B TECHNICAL SUPPORT

This appendix provides additional detail to support the evaluation of Technical Assessment Question B to determine if the toxicity values used in support of the 2005 ROD remain valid. In addition, a summary of the vapor intrusion exposure pathway is presented since risk methodology for evaluating this exposure pathway have changed since the 2005 ROD.

Groundwater Cleanup Goal Review

The toxicity values used in the human health risk assessment that supported the remedy selection in the 2005 ROD were reviewed. The carcinogenic toxicity value review (Table I-1) shows the toxicity values for evaluating oral and inhalation exposures to TCE have become more stringent as the cancer potency is higher (e.g., more toxic). The review of the noncancer toxicity values (Table I-2) for oral and inhalation exposure to PCE, TCE and 1,2-cis-DCE (oral only) shows that the toxicity values have become more stringent and more toxic as the toxicity values are lower in 2021, which means that a lower dose can cause a noncancer health effect.

These changes do not affect the protectiveness of the groundwater remedy because the EPA selected the MCLs as the groundwater cleanup levels and the MCLs have not changed. However, it is important when evaluating the vapor intrusion exposure pathway that the most current inhalation toxicity values be used to reflect the more-stringent values. A review of the most recent vapor intrusion study published in 2021[2] shows that the most current toxicity values are being used to evaluate this exposure pathway.

Table I-1: Evaluation of 2005 ROD Carcinogenic-based Toxicity Values

COC	Oral toxicity			Inhalation Toxicity		
	2005 Oral Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$	2021[a] Oral Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$	Change	2005 Unit Risk Factor $(mg/m^3)^{-1}$	2021[a] Unit Risk Factor $(mg/m^3)^{-1}$	Change
PCE	5.20E-02	2.1E-03	Less toxic	5.8E-04	2.6E-04	Less toxic
TCE	1.10E-02	4.6E-02	More toxic	1.7E-03	4.1E-03	More toxic
cis-1,2-DCE	NA	NA	No change	NA	NA	No change
Vinyl chloride	1.50E+00	7.2E-01	Less toxic	8.8E-03	4.4E-03	Less toxic

Notes:
mg/kg/day = milligrams per kilogram per day
mg/m^3 = milligrams per cubic meter
NA = not applicable; the EPA has not established toxicity values for this chemical.
Source: EPA's Integrated Risk Information System (https://cfpub.epa.gov/ncea/iris/search/index.cfm?keyword=), accessed 9/10/2021.

Table I-2: Evaluation of 2005 ROD Noncancer-based Toxicity Values

Contaminants	Oral toxicity			Inhalation Toxicity		
	2005 Oral Reference Dose (mg/kg/day)	2021 Oral Reference Dose (mg/kg/day)	Change	2005 Reference Concentration (mg/m^3)	2021 Reference Concentration (mg/m^3)	Change
PCE	1.00E-02	6.0E-03	More toxic	6.00E-01	4.0E-02	More toxic
TCE	6.00E-03	5.0E-04	More toxic	2.10E-02	2.0E-03	More toxic
cis-1,2-DCE	1.00E-02	2.0E-03	More toxic	3.50E-02	NA	Withdrawn value
Vinyl chloride	3.00E-03	3.0E-03	None	1.00E-01	1.0E-01	No change

[2] Vapor Intrusion Assessment Report, OU2 Lockwood Solvent Groundwater Plume Site, Billings, Montana. August 2021.

Notes:
NA = not applicable; the EPA has not established toxicity values for this chemical.
mg/kg/day = milligrams per kilogram per day
mg/m^3 = milligrams per cubic meter
Source: EPA's Integrated Risk Information System (https://cfpub.epa.gov/ncea/iris/search/index.cfm?keyword=), accessed 9/10/2021.

Soil Cleanup Goal Review

Cleanup levels for soil were based on leaching to groundwater. In addition, toxicity values have changed for several of the COCs. To evaluate whether the cleanup levels would be protective for unrestricted use in the event the properties are used for residential purposes, the OU2 soil cleanup levels were compared to the EPA's RSLs, based on a standard default resident. As shown, the soil cleanup levels OU2 are protective of residential exposure because they are equivalent to a cancer risk level below or within the EPA's risk management range of 1×10^{-6} to 1×10^{-4} or equivalent to a noncancer HQ below the threshold of 1.0 (Table I-3).

Table I-3: Screening-Level Risk Evaluation of OU2 Soil Cleanup Levels

COC	OU2 ROD Soil Cleanup Level (mg/kg)	Residential RSL[a]		Cancer Risk[b]	Noncancer HQ[b]
		Risk-based (10^{-6} Risk)	Noncancer-based (HQ = 1)		
PCE	0.65	24	81	3×10^{-8}	0.008
TCE	0.72	0.94	4.1	8×10^{-7}	0.2
Cis-1,2-DCE	4.90	-	160	-	0.03
Vinyl chloride	0.16	0.059	70	3×10^{-6}	0.002

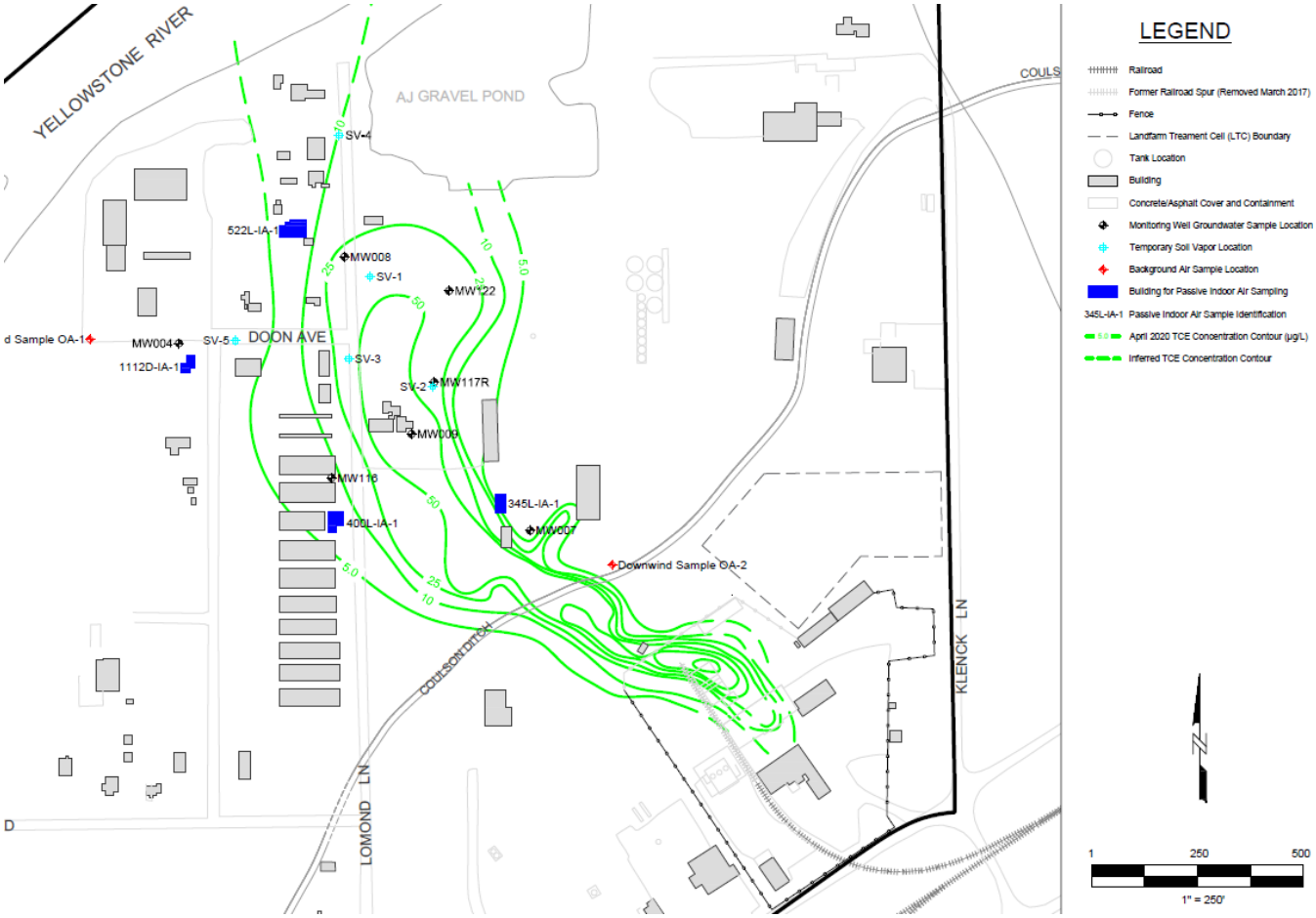
Notes:
a. Current EPA RSLs, dated May 2021, are available at https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables (accessed 7/21/2021).
b. The cancer risks were calculated using the following equation, based on the fact that RSLs are derived based on 1×10^{-6} risk: cancer risk = (cleanup level ÷ cancer-based RSL) × 10^{-6}.
c. The noncancer HQ was calculated using the following equation: HQ = cleanup level ÷ noncancer-based RSL.
– = risk or HQ not calculated as inhalation toxicity value not established by the EPA.
mg/kg = milligrams per kilogram

2021 VIA – OU2

Soco completed a VIA in 2021 to evaluate current conditions in inhabited structures at OU2 to determine if vapor intrusion is occurring to an extent that poses a risk to human health. The VIA included the collection of soil vapor and groundwater samples in April 2021 and passive indoor air and ambient outdoor air samples from April through May 2021. Soco sampled five structures believed to have the highest chance of having elevated indoor air COC concentrations (Figure I-1). These five structures are a subset of the structures evaluated in the 2015 VIA based on a number of factors:

- Historic COC concentrations in sub-slab vapor and indoor air.
- Willingness of homeowners to participate in previous assessments.
- Proximity to the release area and to groundwater with elevated dissolved COC concentrations.
- Comparison of current dissolved COC concentrations to dissolved COC concentrations at the time of previous VIAs and the corresponding indoor air concentrations, and the type of construction of each structure.

Figure I-1: OU2 2021 VIA Study Area



Source: Vapor Intrusion Assessment Report – Operable Unit 2. Lockwood Solvent Groundwater Plume Site. Billings, Montana. Prepared by Tasman Geosciences, Inc. August 2021.

Table I-4 shows that only one structure showed exceedances of the indoor air RSLs, which is consistent with the 2015 VIA. The remaining structures show lower concentrations in indoor air since the previous sampling events in 2013 (Figures I-2 to I-5). To determine if the vapor intrusion exposure pathway poses a concern at 522L, the indoor air concentrations were entered into the EPA's VISL calculator. Table I-5 shows that the measured indoor air concentrations are associated with cancer risks within the EPA's risk management range and below the noncancer threshold of 1.0. Vapor intrusion continues to be monitored to ensure this pathway is addressed during ongoing remediation of the subsurface contamination.

Table I-4: Summary of the OU2 2021 VIA Results

Structure	Indoor Air COC > Indoor Air 2020 RSL (10^{-6} Risk)	COCs Detected in Indoor Air	COCs Detected in Soil Vapor
Residence-1112D	None	PCE - -	PCE TCE cis-1,2-DCE
Residence-345L	None	PCE TCE -	PCE TCE cis-1,2-DCE
Business-400L[a]	None	- TCE -	- TCE cis-1,2-DCE
Residence-522L	PCE TCE -	PCE TCE cis-1,2-DCE	PCE TCE cis-1,2-DCE

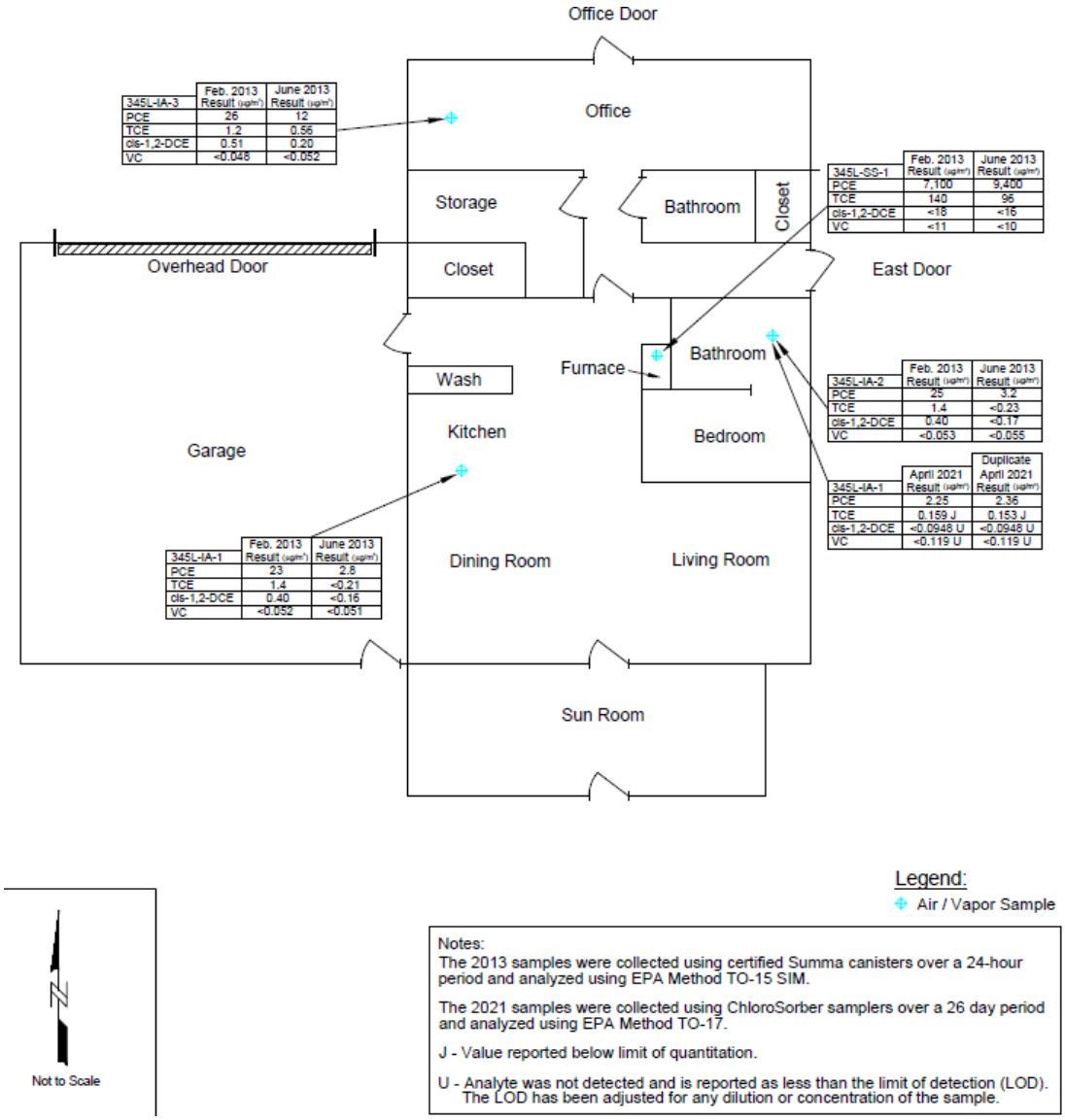
Notes:
a. Based on samples from the office bathroom at this location.
– = below detection for the four COCs (PCE, TCE, cis- and trans-1,2-DCE and vinyl chloride).
Source: Indoor air results from Table 2 and soil vapor results from Table 3 from the 2021 VIA Study. Prepared by Tasman Geosciences. August 2021.

Table I-5: OU2 Screening-Level Residential Vapor Intrusion Evaluation of Residence – 522L

COC	April 2021 Indoor Air Concentration[a] (µg/m^3)	VISL Calculator Output[b]	
		Cancer Risk	Noncancer HQ
PCE	13.2	1.2×10^{-6}	0.32
TCE	0.922	1.9×10^{-6}	0.44
Cis-1,2-DCE	0.692	-	-
Vinyl chloride	<0.115	6.9×10^{-7}	0.001
Cumulative Total		3.8×10^{-6}	0.76

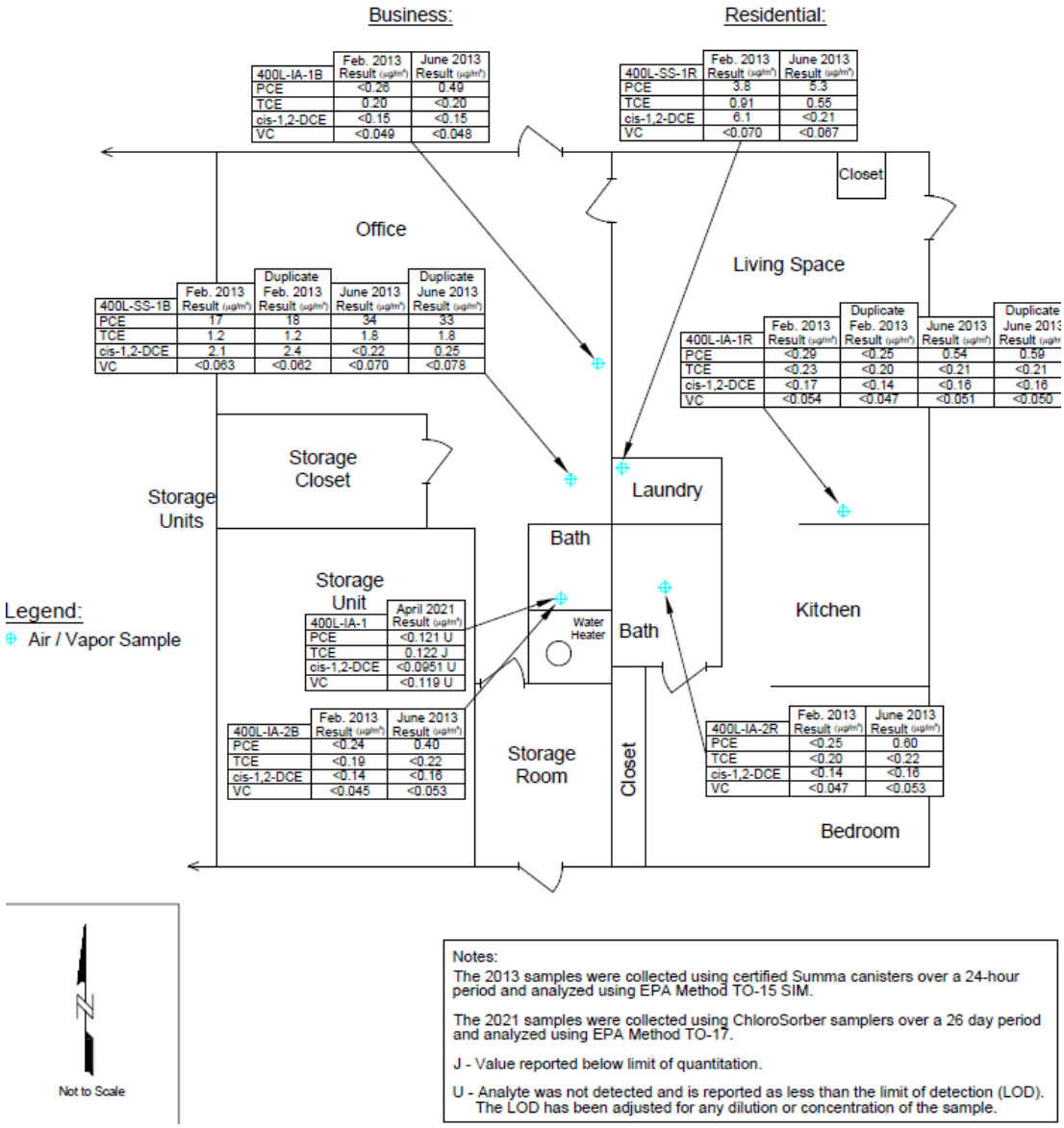
Notes:
a. Concentrations obtained from Table 2 of the 2021 Vapor Intrusion Assessment. Prepared by Tasman Geosciences, Inc. August 2021.
b. Risk and HQ calculated using EPA's 2021 VISL calculator (https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator), assuming a residential exposure and default groundwater temperature of 25 degrees Celsius (accessed September 2, 2021).
= inhalation toxicity values have not been established for this contaminant.
µg/m^3 = micrograms per cubic meter

Figure I-2: Indoor Air Concentrations in 345L, 2013 and 2021



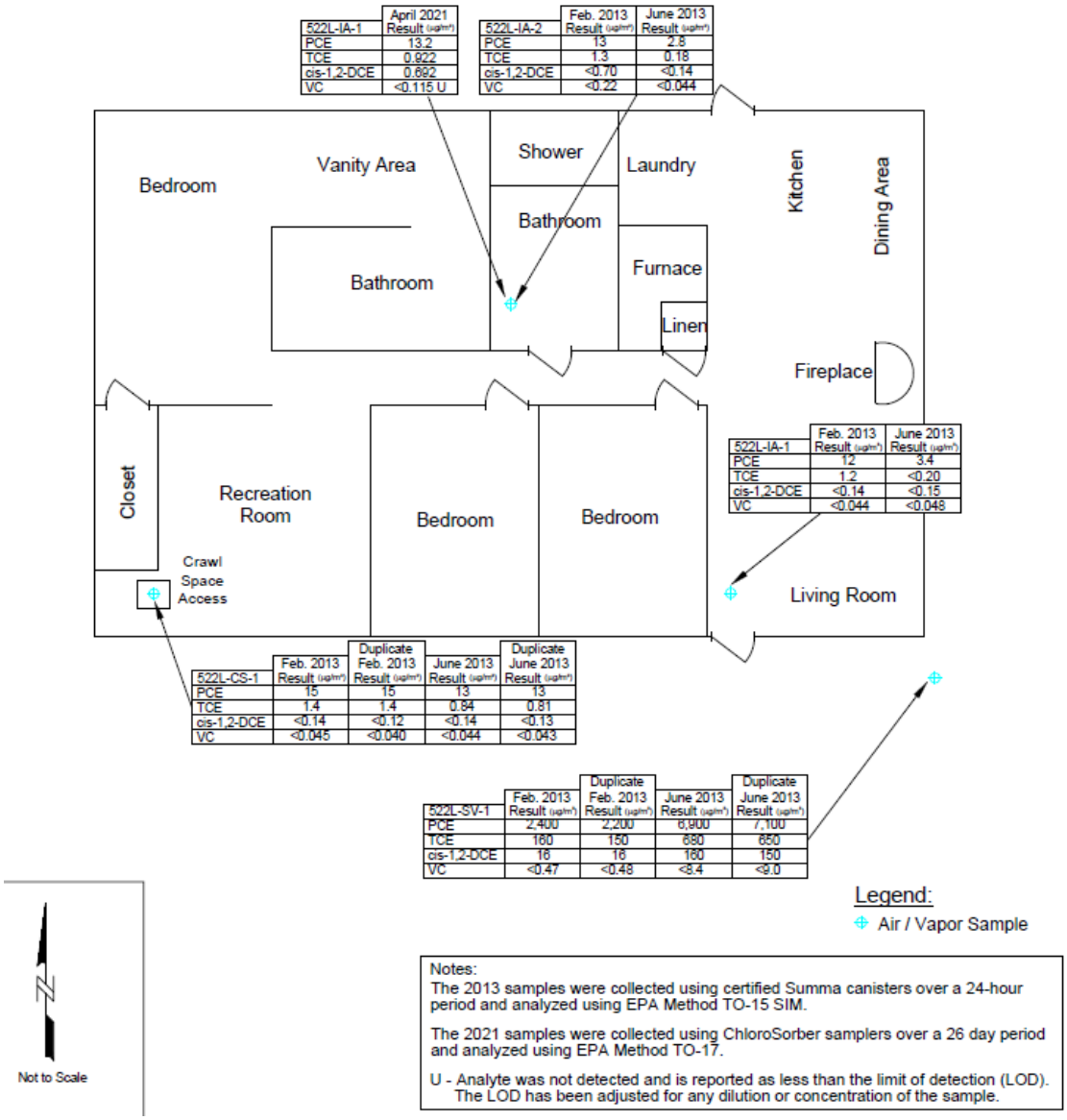
Source: Vapor Intrusion Assessment Report – Operable Unit 2. Lockwood Solvent Groundwater Plume Site. Billings, Montana. Prepared by Tasman Geosciences, Inc. August 2021.

Figure I-3: Indoor Air Concentrations in 400L, 2013 and 2021



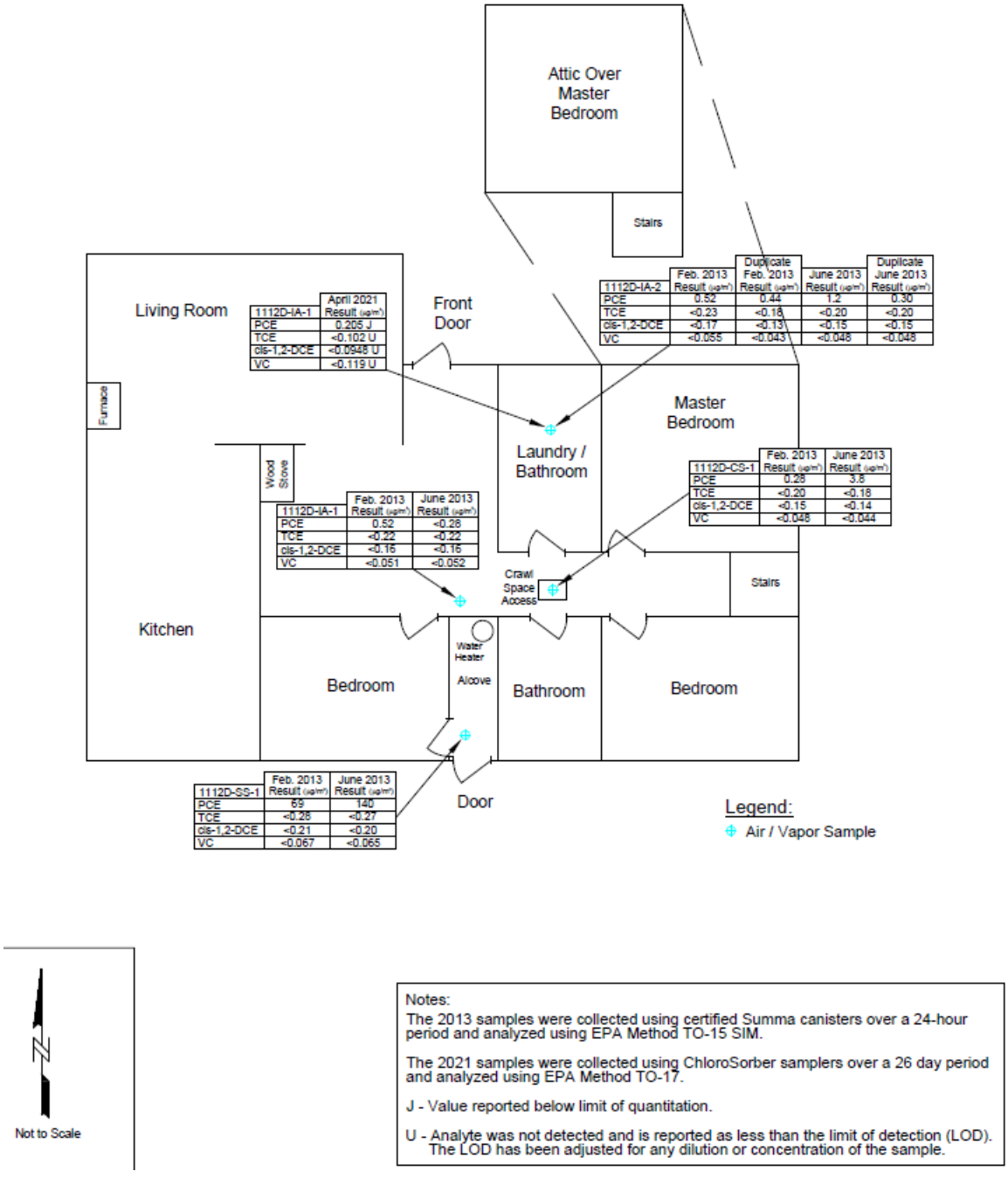
Source: Vapor Intrusion Assessment Report – Operable Unit 2. Lockwood Solvent Groundwater Plume Site. Billings, Montana. Prepared by Tasman Geosciences, Inc. August 2021.

Figure I-4: Indoor Air Concentrations in 522L, 2013 and 2021



Source: Vapor Intrusion Assessment Report – Operable Unit 2. Lockwood Solvent Groundwater Plume Site. Billings, Montana. Prepared by Tasman Geosciences, Inc. August 2021.

Figure I-5: Indoor Air Concentrations in 1112D, 2013 and 2021



Source: Vapor Intrusion Assessment Report – Operable Unit 2. Lockwood Solvent Groundwater Plume Site. Billings, Montana. Prepared by Tasman Geosciences, Inc. August 2021.

APPENDIX J – CONTROLLED GROUNDWATER AREA

BEFORE THE DEPARTMENT OF NATURAL RESOURCES
AND CONSERVATION OF THE STATE OF MONTANA

In the matter of the adoption of New Rule I regarding the Lockwood Solvent Groundwater Plume Site Controlled Groundwater Area	))))	NOTICE OF ADOPTION

TO: All Concerned Persons

1. On July 20, 2018, the Department of Natural Resources and Conservation published MAR Notice No. 36-22-198 pertaining to the public hearing on the proposed adoption of the above-stated rule at page 1383 of the 2018 Montana Administrative Register, Issue Number 14.

2. The department has adopted the following rule as proposed, but with the following changes from the original proposal, new matter underlined, deleted matter interlined:

NEW RULE I (36.12.907) LOCKWOOD SOLVENT GROUNDWATER PLUME SITE CONTROLLED GROUNDWATER AREA (1) There is designated a Lockwood Solvent Groundwater Plume Site Controlled Groundwater Area (LSGPS CGWA). The LSGPS CGWA means an area of approximately ~~336~~ 331 acres located east of Billings, Montana, and is generally described as follows:

(a) The LSGPS CGWA covers an area approximately ~~0.54~~ 0.52 square miles and is generally located south and east of the Yellowstone River at Lockwood, Montana, between Rosebud Lane to the south, the Yellowstone River to the north and west, and Maier Road on the east (the east Section line of Sections 26 and 35, T1N, R26E). The boundaries are wholly within: N2N2 Section 35, T1N, R26E; S2 Section 26, T1N, R26E; and S2N2 Section 26, T1N, R26E.

(b) through (4) remain as proposed.

3. The department has thoroughly considered the comments and testimony received. A summary of the comments received, and the department's responses are as follows:

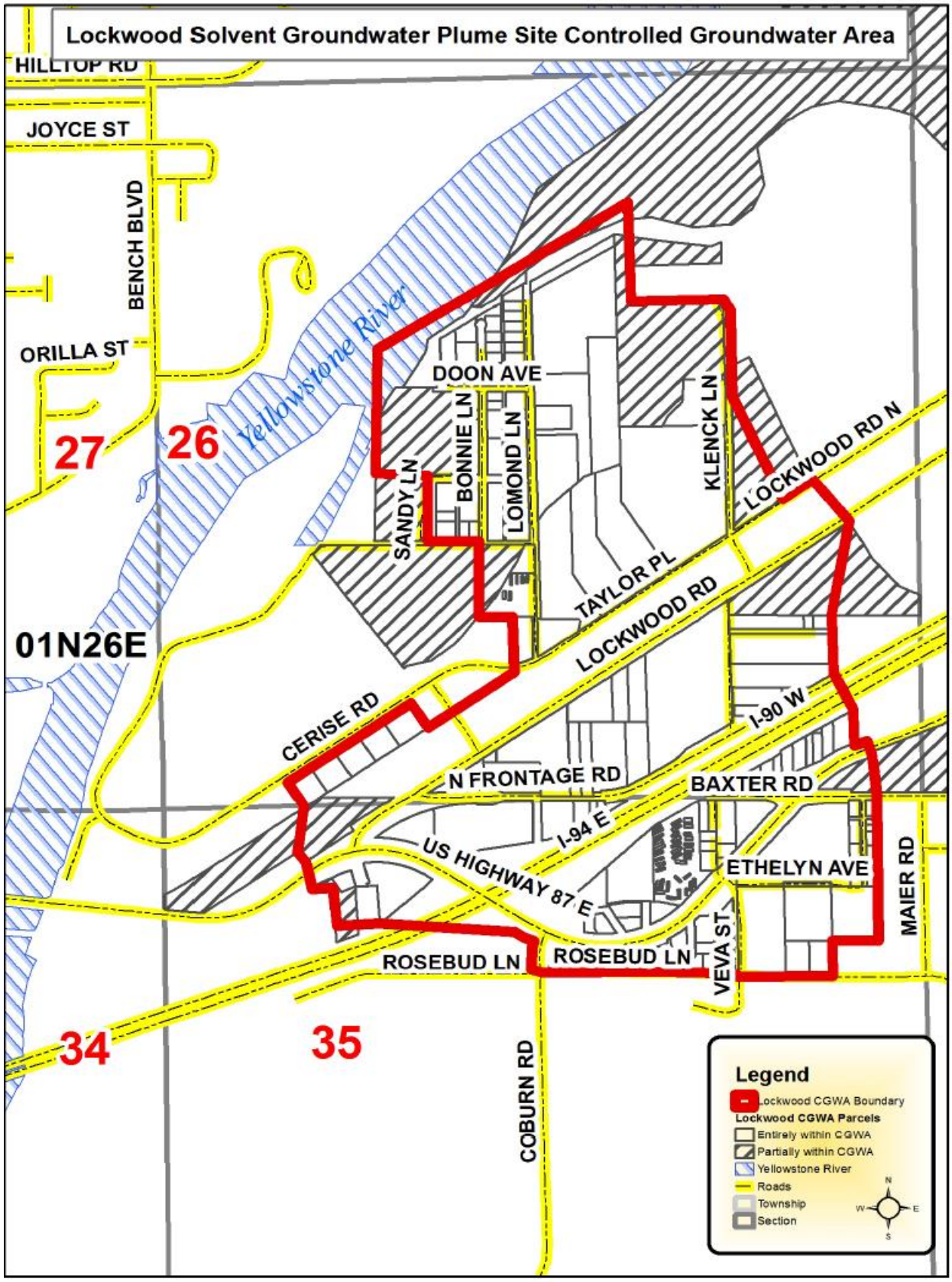
COMMENT 1: The department received a comment requesting that the department modify the boundary of the proposed Lockwood Solvent Groundwater Plume Site Controlled Groundwater Area (LSGPS CGWA). The request was to move the boundary approximately 250 feet southwest along the parcels owned by the individual making the request, thereby excluding the easternmost portion of the southern parcel (geocode: 03-1033-26-4-13-01-0000) and entire northern parcel (geocode: 03-1033-26-4-13-11-0000) from the LSGPS CGWA. Evidence within the application was cited to demonstrate that a well drilled on the northern parcel or the eastern portion of the southern parcel should not induce plume migration.

RESPONSE TO COMMENT 1: The department agrees. Wells located within roughly 650 feet of the plume could cause plume migration. The northernmost parcel requested to be removed lies completely outside this zone, and the southern parcel lies partially outside this zone. The original proposed boundary simply followed parcel borders, and therefore, included some areas more than 650 feet from the plume. Upon consideration of the comment and further discussion with the engineer who prepared the petition materials on behalf of RiverStone Health, the department has determined modification of the proposed LSGPS CGWA boundary is appropriate. The rule is amended as requested to exclude the northern parcel, and easternmost section of the southern parcel. Approximately five acres of land were removed from the proposed LSGPS CGWA. A map reflecting the amended boundary is available at http://dnrc.mt.gov/divisions/water/water-rights/controlled-ground-water-areas/lockwood.

/s/ John E. Tubbs
JOHN E. TUBBS
Director
Natural Resources and Conservation

/s/ Brian C. Bramblett
BRIAN C. BRAMBLETT
Rule Reviewer

Certified to the Secretary of State September 25, 2018.


Lockwood Solvent Groundwater Plume Site Controlled Groundwater Area
HILLTOP RD
JOYCE ST
BENCH BLVD
ORILLA ST
Yellowstone River
27
26
DOON AVE
SANDY LN
BONNIE LN
LOMOND LN
KLENCK LN
LOCKWOOD RD N
TAYLOR PL
LOCKWOOD RD
01N26E
CERISE RD
I-90 W
N FRONTAGE RD
BAXTER RD
I-94 E
US HIGHWAY 87 E
ETHELYN AVE
MAIER RD
VEVA ST
ROSEBUD LN
ROSEBUD LN
34
35
COBURN RD
Legend
Lockwood CGWA Boundary
Lockwood CGWA Parcels
Entirely within CGWA
Partially within CGWA
Yellowstone River
Roads
Township
Section
N
W
E
S